SP-150498
(New)

SPECIAL PROVISIONS
FOR
INTERSECTION CONFLICT WARNING SYSTEMS

Statewide
HSIPX-000-T(2)--3L-00

Effective Date
April 16, 2019

THE STANDARD SPECIFICATIONS, SERIES 2015, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

150498.01 DESCRIPTION.

A. This project involves furnishing and installing conduit, pull boxes, tracer wire, power supplies, cabling, cabinets, major warning sign assemblies, LED sign lights, foundations, poles, video detection systems, loop detectors, and other hardware deemed necessary for complete and functional Intersection Conflict Warning Systems (ICWS) at the locations identified in the plans. The Contractor is responsible for furnishing and installing all necessary components for a fully-functional and operational ICWS system.

B. Related Specifications and Standards.
The work as detailed on the plans for the ICWS installations shall be completed in accordance with the contract documents and the documents listed below.

1. NEC, latest edition adopted by the State of Iowa.

2. Telecommunications Industry Association/Electronic Industries Association (TIA/EIA) latest editions.

C. Contractor's Responsibility.

1. One Call Locating.
Until final acceptance, provide all utility locates of the work performed under this contract when requested through One-Call services or by the Engineer. Perform any such locations within 48 hours of receiving notice that such locations are needed.

2. Conduit Locations.
Prior to final acceptance, the Contractor shall meet with the Engineer to demonstrate the locate system is working properly throughout the entire conduit system.

3. Existing Systems.

The inplace (existing) Intersection Conflict Warning Systems at each site shall remain operational at all times during construction. As the existing and proposed systems are independent of one another, with the exception of a shared power and battery back-up service, there should be no circumstance which requires the deactivation of the existing warning system. The Engineer must approve any system interruptions with written permission a minimum of 24 hours prior to the interruption.

4. Fully Operational System.

a. The Contractor is ultimately responsible for a fully operational and functional Intersection Conflict Warning System (ICWS) as shown and described in the contract documents.

b. The proposed system shall operate independently and concurrently with the existing ICWS system at each site, sharing only the battery backup system and power service. The proposed ICWS system shall detect minor road and mainline turning traffic using video or loop detection points on all approaches as shown in the plans to alert mainline traffic via flashing amber beacons mounted on proposed Major Road Warning Sign Assemblies.

c. The system shall operate by activating the major road flashing amber beacons as vehicles approach and wait at the intersection from the minor road approaches. The flashing beacons shall continue to flash until the vehicle has cleared the intersection and is no longer a potential hazard to oncoming mainline traffic. A timing chart will be provided by the Engineer prior to construction. Check with the Engineer for any timing modifications before setting timing on system activation delays/extensions.

d. The proposed ICWS system shall have a false alert/activation rate of no more than 2% over a period of 20 minutes in all weather and environmental conditions. The system must activate only when vehicles are present at the detection points. False activations diminish the effectiveness of the ICWS System. Similarly, no vehicles shall go undetected. It is critical that the system operates with near 100% accuracy to ensure the safety of the traveling public.

5. System Failures.

a. All power to the proposed system shall be obtained through a connection to the existing battery back-up system. Ensure that the system continues to function properly during a power failure event by flipping the main breaker at the main power service. Also ensure the existing (inplace) system continues to operate during the power failure event.

b. In the event of a malfunctioning detector (loop or video), such as a permanent open or close call event, the system shall revert to an always-on, fail-safe state. The beacons shall continuously flash until the system is repaired or reset. Under no circumstances shall the system shutdown or fail to activate beacons in the event of any type of failure. Simulate and demonstrate these failures to the Engineer prior to final acceptance of the system.

6. Final Acceptance Testing.

The Engineer will perform a final inspection and test of the system at each location, known as 'Final Acceptance Testing'. The Contractor shall be present for Final Acceptance Testing and shall have all available tools, hardware, and software necessary to make spot corrections to both physical installations and system logic programming. Contractor shall work to schedule Final Acceptance Testing with the Engineer after each site is fully constructed and operational. Final Acceptance Testing will include a complete demonstration of each component of the system, modification of delay and extend timings, as directed by the Engineer, and demonstration of the various system failures listed in Article 150498.01, C, 5. Detailed test procedures will be provided by the Engineer prior to construction. Final Acceptance Testing shall be incidental to the Control Cabinet & Foundation bid item.

D. Existing Utility Conflicts.

1. **Planned Work Near Existing Utilities.**
   The Contractor is responsible for making all necessary One Call locate requests for all work performed. Coordinate with existing utilities and the Engineer to ensure no damage to existing infrastructure occurs. Conduit routing shown in the plans is for reference and may be adjusted with approval from the Engineer. The Contractor is responsible for locating all existing ICWS system components and infrastructure – the Iowa DOT will not locate existing underground facilities and does not have any records of the in-place ICWS infrastructure.

2. **Unplanned Conflicts.**
   - **a.** The Contractor shall be responsible for repairing, to the affected utility's satisfaction and at no cost to Iowa DOT, any damage the Contractor causes to existing utilities and systems during the life of the project.
   - **b.** In the event of a conflict or utility hit, simultaneously notify the Engineer and affected parties and immediately stop all work in progress and shall expend all of its efforts to restore the disrupted system(s) and/or correct the problem causing the disruption. The notice shall include the type of facility damaged and the extent of the damage.
   - **c.** Remain on site until the affected utility confirms that the disrupted systems are fully operational. An extension of time will not be granted for delays caused by repairing disrupted systems.

E. Contractor Submissions.

1. **Materials List.**
   Complete and submit one electronic PDF file of the Materials List within 14 calendar days after award of the project contract. Include the name of the materials, supplier, and catalog number of each item listed.

2. **Construction Schedule.**
   - **a.** Within 30 days after award of contract or before the construction kickoff meeting, submit to the Engineer one electronic pdf file of the detailed construction schedule including dates of commencement for each major work item, duration of each major work item, and completion of each major work item for each site of the proposed construction.
   - **b.** Major items of work to be included on the schedule are: installation of conduit, pull boxes, device poles and foundations, device cabinets and foundations, and electrical installations. Each site shall be included in the proposed schedule.
   - **c.** Upon acceptance of the schedule, adhere to the dates as proposed unless modified with the approval of the Engineer.
   - **d.** Submittal and approval of the proposed construction schedule by the Engineer is required before construction activities can commence.

3. **Shop Drawings.**
   - **a.** After approval of the Materials List and before any items are ordered, submit the Shop Drawings for approval according to Article 1105.03 of the Standard Specifications.
   - **b.** The Engineer will review the shop drawings/catalog cuts for the purpose of assuring general conformance with the project design concept and contract documents.
   - **c.** Provide written notice of any deviations from the requirements of the contract documents.
   - **d.** Engineer's approval of shop drawings/catalog cuts does not relieve the Contractor of responsibility for providing satisfactory materials complying with the contract documents. Errors not detected during review do not authorize the Contractor to proceed in error. A fully operational and functioning system is ultimately the responsibility of the Contractor.
   - **e.** Provide a detailed wiring diagram for each site. Include model numbers for each specific piece of equipment planned for use within the cabinet.

4. **Warranty.**
   - **a.** Transfer all required standard materials warranties on the date of final acceptance to the Iowa DOT.

b. Warranty periods shall not commence prior to final acceptance of the work.
c. The system, in its entirety, shall be warranted for a period of 90 days beyond final acceptance for each site. Repair or replace any faulty equipment or materials within this timeframe, as directed by the Engineer.

F. As-Built Documentation.

1. General.
a. As-built record plans will be the responsibility of, and completed by, the Contractor. As such, ensure that a master record set of the plans is maintained throughout construction to document all installations and any deviations from the design shown in the contract documents.
b. Maintain written records of daily construction progress, areas worked, and quantities installed to aid in the completeness of as-constructed documentation.

2. GPS Data Recording Staking Assistance.
Collect GPS data of all installations including, but not limited to: conduit routing, pull boxes, device poles, device cabinets, loops, signs, and power supplies. Every effort shall be made to collect daily construction GPS data.

150498.02 MATERIALS.

A. General.
Provide any items, equipment, or materials not specifically addressed in the contract documents but required to provide a complete and functional installation. The level of quality shall be consistent with other specified items. All miscellaneous electrical equipment and materials shall be listed for its specific application.

B. Control Cabinet and Foundation.
All control cabinets and foundations shall be furnished and installed. Submit shop drawings for cabinets and materials/equipment to be used within the cabinet. A clearly labeled wiring and equipment diagram shall be submitted and approved by the Engineer prior to construction. Furnish all work, apparatus, and materials to construct and install the control cabinets designed to house the control equipment required for the proposed ICWS system. Foundations installed for cabinets shall be included in the Control Cabinet and Foundation Bid Item.

1. General.
a. Furnish materials of new stock only.
b. Cabinets shall be pad-mounted.
c. Cabinets shall be corrosion resistant, NEMA Type 3R compliant, constructed of welded sheet aluminum with a minimum nominal thickness of 1/8 inch.
d. Cabinets shall be complete with all required internal components, fully wired, DIN rails, terminal strips, and stainless-steel hardware.
e. Cabinets shall meet the requirements of ASTM B-209 for 5052-H32 aluminum sheet. The aluminum shall be smooth and the exterior shall be left in its unpainted natural color.
f. All exterior seams for cabinet and doors shall be continuously welded.
g. Cabinets shall be equipped with the appropriate anchor bolts required to secure the cabinet to the foundation.
h. Cabinet foundations shall meet all foundation requirements listed in the Standard Specifications and this special provision.
i. All equipment installed within the control cabinet shall be rated for outdoor, roadside conditions with operating temperatures between -10°F and +100°F.

2. Cabinet Doors.
a. Cabinets shall be equipped with both a front and rear door. The cabinet doors shall be

sturdy, torsionally rigid, and attached by a continuous heavy-duty stainless-steel butt hinge. The door shall substantially cover the full area of the front of the cabinet and have a stainless steel, pad-lockable handle.

b. The cabinet doors shall be provided with a door stop catch mechanism to hold the doors open at three positions; 90 degrees, 120 degrees and 180 degrees. Both the door and door stop mechanism shall be of sufficient strength to withstand a wind load of five pounds per square foot of door area applied to both inside and outside surfaces.

c. A neoprene gasket shall be provided to act as a permanent and weather resistant seal at each cabinet door facing. The gasket material shall be of a non-absorbent material and shall maintain its resiliency after long-term exposure to the outdoor environment. The gasket shall have a minimum thickness of 1/3 inch. The gasket shall be located in a channel provided for this purpose either on the cabinet or on the door. An "L" bracket is acceptable in lieu of this channel if the gasket is fitted snugly against the bracket to ensure a uniformly dust and weather resistant seal around the entire door facing.

d. LED cabinet lights shall be provided and operated by door switch. LED lights shall be outdoor rated.

e. Each cabinet door shall be provided with a high quality, heavy duty tumbler-type lock. Two, No. 2 keys for each tumbler lock shall be provided to the Engineer for each cabinet. All locks for the project shall be keyed identically to key pattern 9R46142 or as otherwise identified by the Engineer. Keys shall be given to the Engineer. Do not attach keys to the exterior of the cabinet at any time during storage or installation.

f. A heavy-duty clear plastic envelope shall be provided, securely attached to a cabinet door via welded hooks, for stowing cabinet wiring diagrams and equipment manuals. Minimum dimensions shall be 9 inches wide by 12 inches deep.

3. Electrical Components, Connecting Cables, and Wiring for 120V Configuration.

a. Provide cabinets equipped and configured with internal power components necessary to operate all equipment for a fully-functional ICWS system, including, but not limited to:

1) One four position service entrance terminal block with tin plated aluminum connectors, nickel plated steel screws, and a current rating up to 70 Amps.

2) One 20 Amp single pole breaker (Main).

3) One 15 Amp single pole breaker (Equipment).

4) One 15 Amp single pole breaker (Auxiliary).

5) One 120/240 VAC surge protector with surge current at minimum of 100 KA, nanosecond response time, and an operating temperature of -40°F to +185°F.

6) One auxiliary four-terminal electrical block rated for a maximum 250 VAC RMS maximum voltage and 20 Amps current.

7) One 15 Amp GFCI receptacle in Ivory color.

8) One 15 Amp Duplex receptacle in Ivory color.

9) One rack-mounted, eight-outlet Power Distribution Unit with built in surge suppressor (1800 Joules of surge/lightning protection) that includes a resettable circuit breaker and minimum cord length of 6 feet.

10) One seven TAP Ground Bar.

11) One seven TAP Neutral Bar.

12) All miscellaneous wiring, harnesses connectors and attachment hardware.

b. All conductors used on the cabinet wiring shall be No. 14 AWG or larger with a minimum of 19 strands. Conductors shall conform to MIL SPEC MIL-W-168780, Type B or D. The insulation shall have a minimum thickness of 10 MILS. All wiring containing line voltage shall be a minimum size of No. 12 AWG.

4. Ventilation.

a. Vents.

1) Furnish cabinets containing a suitably designed rain-tight vent or vents that:

- Are equipped with suitable screens or dust filters, and
- Allow the release of excessive heat and/or any explosive gases which may enter the cabinet.

2) Ensure when filters are utilized, positive retainment is provided on all sides to prevent warpage and entry of foreign matter around the edges.

3) The filters shall be dry type, easily removed and replaced, and standard dimensions, commercially available.

b. Vent Fan.

Meet the following requirements:

1) A thermostatically controlled vent fan is furnished and installed to provide air circulation within the cabinet.

2) The thermostat controlling the fan is manually adjustable to turn on between 90°F and 150°F with a differential of not more than 10°F between automatic turn on and turn off.

3) The fan is located with respect to the vent holes to direct the bulk of the air flow over the internal components within the cabinet.

4) Ventilation fan shall be fused separately and wired after the main AC+ circuit breaker.

5. Grounding.

a. The cabinet internal ground shall consist of one or more ground bus-bars permanently affixed to the cabinet and connected to the grounding electrode.

b. Use bare stranded No. 6 AWG copper wire between bus-bars and between the bus-bar and grounding electrode.

c. Each copper ground bus-bar shall have a minimum of 20 connector points. Each connector point shall be capable of securing at least one No. 6 AWG conductor.

d. AC neutral and equipment ground wiring shall return to bus-bars.

C. ITS Pole and Foundation.

Furnish and install ITS poles and foundations designed to mount video detectors and future ITS equipment as required for the designed ICWS system. In addition to any Contractor-provided equipment, furnish and install a pull rope from the top of the ITS pole, through the conduit network, to the proposed control cabinet. Contractor is responsible for providing all hardware necessary for securely installing the poles at the locations identified in the plans. Foundations designed and installed for ITS poles shall be included in the ITS Pole and Foundation Bid Item.

1. General.

a. All poles shall be tapered steel poles, 45 feet in length (excluding the transformer base).

b. Poles shall satisfy the Buy America requirements of Section 1107.06 of the Standard Specifications.

c. The poles shall be designed to satisfy deflection requirements.

d. The poles shall be provided with two handholes with removable covers. The handhole openings shall be reinforced with a minimum 0.432 inch wide hot rolled steel rim. The first handhole shall be located 1.5 feet above the base plate (measured from bottom lip of handhole) and have minimum outside dimensions of 6 inches by 10 inches. The second handhole shall be oriented directly above the first handhole but located 45 feet above the baseplate (measured from bottom lip of handhole) and have minimum outside dimensions of 3 inches by 5 inches.

e. Ensure each pole has an approved grounding provision for use during installation and that it is accessible and will function as intended after the galvanization process. Ensure the grounding lug is readily accessible through the handhole and from the bottom of the pole shaft.

f. Poles shall include a removable cap at the top of the pole with a J-hook cable support above the upper handhole.

g. Ensure the poles and base plates are hot dip galvanized inside and out according to ASTM A123.

h. Unless otherwise noted in this specification, materials shall meet the applicable minimum requirements of Section 4185 of the Standard Specifications.

i. Contractor shall submit a foundation design for the proposed ITS poles for approval by the Engineer. The foundation design, fabrication, and installation are all part of the ITS Pole and Foundation bid item.

2. Pole & Foundation Design Calculations and Fabrication Specifications

a. All poles and foundations shall be designed in accordance with the AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, 2013".

b. The device loadings specified in this document shall be used in all AASHTO design calculations and pole deflection evaluations and the poles and foundations shall be capable of withstanding winds up to 90 mph with a 1.14 gust factor without failure utilizing the device loadings specified. Calculations and detailed drawings shall be submitted demonstrating compliance with the AASHTO specification.

c. All materials and products shall be manufactured in the United States of America and comply with ASTM or AASHTO specifications. Mill certifications shall be supplied as proof of compliance with the specifications. The Fabricator shall be certified under Category I, "Conventional Steel Structures" as set forth by the American Institute of Steel Construction Quality Certification Program. Proof of this certification will be required to ensure that the fabricator has the personnel, organization, experience, procedures, knowledge, equipment, capability and commitment to fabricate quality pole structures. All welding shall be in accordance with Sections 1 through 8 of the American Welding Society (AWS) D1.1 Structural Welding Code. Tackers and welders shall be qualified in accordance with the code. Tube longitudinal seam welds shall be free of cracks and excessive undercut, performed with automatic processes, and be visually inspected. Longitudinal welds suspected to contain defects shall be magnetic particle inspected. All circumferential butt-welded pole and arm splices shall be ultrasonically or radiographically inspected.

d. All poles and foundations shall be designed to support a standard Iowa DOT Traffic Camera (currently the Axis Q6000-E Mk II PTZ Network Camera) and video detector and shall be stiffened or otherwise manufactured to meet allowable deflection criteria contained herein. Pole and foundation design shall assume the following loadings. All mounting heights are measured from the base of foundation to bottom of equipment.

Radio Communication Equipment and Mounting Bracket
Weight: 10 pounds
Surface Area: 3 square feet
Mounting Height: 45 feet

Traffic Camera and Mounting Bracket
Weight: 17 pounds
Surface Area: 1.5 square feet
Mounting Height: 40 feet

Video Detection Camera
Weight: 15 pounds
Surface Area: 1.5 square feet
Mounting Height: 40 feet

e. The pole top deflection shall not exceed one inch in a 30 mph (non-gust) wind. Close consideration must be given to the effective projected area of the equipment along with the weight when designing the pole to meet the specified deflection performance criteria. The calculations shall include a pole, base plate, and anchor bolt analysis. The pole calculations shall be analyzed at the pole base, at 5 foot pole intervals/segments and at any other critical pole section. At each of these locations, the following information shall be given:

- The pole's diameter, thickness, section modulus, moment of inertia, and cross-sectional area.
- The centroid, weight, projected area, drag coefficient, velocity pressure, and wind force of each pole segment.
- The axial force, shear force, primary moment, total moment, axial stress, bending stress, allowable axial stress, allowable bending stress, and combined stress ratio (CSR).
- The pole's angular and linear deflection.

f. All pole shafts shall have a minimum yield strength of 55 ksi and conform to ASTM A595 Grade A or ASTM A572 Grade 55. The shaft shall have a constant linear taper and contain only one longitudinal seam weld. Circumferential welded tube butt splices and laminated tubes are not permitted. Longitudinal seam welds within 6 inches of base plate welds shall be complete penetration welds.

g. Base plates shall conform to ASTM A36. Plates shall be integrally welded to the tubes with a telescopic welded joint or a full penetration butt weld with backup bar.

h. Anchor bolts shall conform to the requirements of ASTM F1554 Grade 105 S4, be full-length galvanized according to ASTM F2329 (with zinc bath temperature limited to 850ºF) or ASTM B695 Class 55 Type 1, and be Unified Coarse Thread Series with Class 2A tolerance. The use of J Bolt anchors is not allowed as anchor bolts shall be straight rods with a nut or a nut and a plate on the bottom threaded end of each rod. Each anchor bolt shall be supplied with three hex nuts and two flat washers. The nuts shall be heavy hex and meet the requirements of ASTM A563 Grade DH or ASTM A194 Grade 2H. Washers shall meet the requirements of ASTM F436. Nuts and washers shall be galvanized according to the requirements of ASTM F2329 (with zinc bath temperature limited to 850ºF) or ASTM B 695 Class 55 Type I. Per Article 4187.01, C, 3, d of the Standard Specifications, the entire anchor bolt assembly is to be galvanized by the same zinc-coating process.

3. Transformer Base.

a. Steel with top and bottom plates conforming to ASTM A36 and walls conforming to ASTM A595 Grade A with a minimum yield strength of 55 ksi.

b. Transformer base shall be designed in accordance with the AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, 2013".

c. Transformer bases need to be designed to be structurally adequate to support the pole loadings.

d. Equipped with a weatherproof access door.

4. Submittals.

a. Submittal shall include all structural calculations and be accompanied by a shop drawing that, at a minimum, illustrates a schematic of the proposed pole, transformer base, and foundation with a summary of the design criteria, material data, pole data, and details of handholes, pole top, pole base and pole orientation.

b. Design calculations shall be sealed by a registered Professional Engineer.

D. Wire and Cable.

Wire requirements as outlined in Section 2525 and Article 4185.12 of the Standard Specifications shall be followed with the added provisions:

1. Power Wires.

a. Detector wires shall be double conductor, stranded copper, Type XHHW, black colored jacket in sizes listed in the contract documents.

b. All power wires shall be stranded copper, Type XHHW, black colored jacket in sizes listed in the contract documents.

2. Tracer Wire.

a. Single conductor copper clad steel, No. 10 AWG with orange colored jacket, UL Listed.
b. Contractor shall use a Tracer-Lock Connector (#TL-LUG-SS) or approved equivalent for all connections.

3. Grounding/Bonding.
Ground all installations using a No. 6 AWG copper, non-insulated wire bonded to copper clad metal, driven electrodes using an exothermic weld.

E. Pull Box.

1. Supply Pull Boxes constructed of epoxy or polyester resin mortar with woven glass fiber reinforcement and an appropriate aggregate dimensioned as indicated in the contract documents.

2. Pull Box materials shall not support combustion when tested in accordance with “Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position” ASTM D-635.

3. Water absorption shall not exceed 2% of the original weight of material under test conditions per “Standard Test Method for Water Absorption of Plastics” ASTM D-570.

4. The Pull Box shall be functional without failure throughout a temperature range of -50°F to +170°F.

5. The Pull Box walls shall not deflect more than 0.24 inches per foot of length of box when installed and subject to an ASTM C-857 TIER 22 load.

6. Pull Boxes shall meet or exceed ANSI/SCTE 77 “Specification for Underground Enclosure Integrity” requirements.

7. Pull Box lid strength shall be tested to 33,750 pounds (Tier 22).

8. Pull Box lids shall be labeled “IOWA DOT – ELECTRIC” or as directed/approved by the Engineer.

F. High Density Polyethylene (HDPE) Conduit.

1. All conduit shall be High Density Polyethylene (HDPE) conduit and shall be smooth wall orange in color.

2. Comply with ASTM F 2160 (conduit) and ASTM D 3350 (HDPE material), minimum SDR 13.5.

3. Sequential foot markings printed on HDPE.

4. Continuous reel or straight pieces to minimize splicing.

5. For dissimilar conduit connections provide an adhesive compatible with both materials.

6. All couplings shall be watertight and rated for direct burial applications.

G. Power Connections.
Power connections shall comply with the requirements of the NEC, contract documents, electrical utility, and all generally accepted standards and requirements for the electrical components and power terminations in the individual power source. All power connections shall be made through the existing battery back-up power supply cabinets.

H. LED Sign Lights.

1. General Requirements.
- **a.** All luminaires shall be solid state lighting sources.
- **b.** A high-intensity white light LED flood lighting luminaire assembly shall be used for illuminating sign faces.
- **c.** Provide products that comply with requirements of NFPA 70.
- **d.** Provide products that are listed and labeled as complying with UL 1598, where applicable.
- **e.** Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
- **f.** Unless specifically indicated to be excluded, provide all required wiring, connectors, hardware, supports, mounting plates and methods, trims, accessories, etc. as necessary for a complete operating system.
- **g.** Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- **h.** Provide luminaires UL listed or CSA certified for wet locations.
- **i.** All exposed hardware shall be either stainless steel or manufactured using corrosion resistant materials finished with the same finishing process as the luminaire.
- **j.** Provide luminaire assemblies that are RoHS Compliant.
- **k.** Ambient Operating Temperature Range Rating shall be -40ºF to 113ºF.

2. Luminaire Housing.
- **a.** Housing material shall be made of non-corrosive stainless steel or aluminum.
- **b.** Housing shall be built to include heat sink to conduct heat away from the LEDs and driver.
- **c.** Heat sink shall be a passive cooling device.

3. Light Source Characteristics.
- **a.** Correlated Color Temperature (CCT) shall be equal to 2700K.
- **b.** Color Rendering Index (CRI) shall be equal or greater to 82.
- **c.** Assembly shall be a sealed optical system rated IP66.
- **d.** Lens shall be extruded polymer refractive lens.

4. Driver Power Supply Units.
- **a.** Driver shall be built integral to the luminaire assembly.
- **b.** Input voltage shall be 120-277V.
- **c.** Assembly shall comply with FCC 47 CFR part 15 non-consumer RFI/EMI standards.
- **d.** Provide with surge protection: L-L or L-N, and L-G.
- **e.** Driver housing rated IP66.
- **f.** Dimming compatible.

5. Absolute Lumen Efficacy Rating shall be 94 lumens per watt or greater.

6. Luminaire power consumption shall be no more than 50 Watts.

7. Each luminaire shall have a minimum expected useful life of 60,000 hours at 25^0C.

8. Luminaire housing assembly shall be mounted with adjustable tilt and rotation.

9. Accessories.
- **a.** Provide each luminaire with cutoff visor to protect lens from debris.
- **b.** Provide each luminaire with slip fitter pole mounting.

10. Finish.

- **a.** Provide same finish to entire luminaire assembly, including luminaire, mounting components, and luminaire accessories.
- **b.** Provide an electrostatically applied polyester powder coat.
- **c.** Coating shall be abrasion, fade, and corrosion resistant.

I. Video Detection.

1. General.

- **a.** This specification sets forth the minimum requirements for a Video Imaging Vehicle Detection System that monitors and provides vehicle stop bar and advance detection at a roadway intersection via processing of video images and provides detector outputs to a loop card, traffic controller, or similar device.
- **b.** Using standard image sensor optics and in the absence of occlusion, the system shall be able to detect vehicle presence with 96% accuracy under normal conditions (days and nights), and 92% accuracy under adverse conditions (fog, rain, snow).
- **c.** All items and materials furnished shall be new, unused, current production models installed and operational in a user environment and shall be items currently in distribution. The detection and data collection algorithms shall have a proven record of field use, with a minimum of 3 years of service.

2. Video Detection for a single intersection will consist of sufficient cameras (as shown on the plans), the field communications link, and the communications manager or processor card rack and shelf mounted detector rack.

3. The communication manager or processor unit(s) must be compatible with NEMA TS1, NEMA TS2 TYPE 1, TYPE 2 and Type 170/2070 equipment. The processor shall be compatible with a NEMA detector rack, a CALTRANS file sharing detector rack, or a shelf mount unit that functions as direct replacement for the detector rack assembly.

4. Video detection shall use high-definition (HD) cameras with an embedded processor for analyzing and performing detection.

5. Video resolution shall be 720p or better.

6. Camera shall have a minimum 10x optical zoom to satisfy across-the-intersection detection objectives, including stop line and advance detection.

7. The camera’s zoom and focus control shall be adjustable by command from the user interface.

8. Camera enclosures shall be waterproof and dust-tight to the latest NEMA-4 or NEMA-6P specifications.

9. Camera enclosures shall allow the camera to operate satisfactorily over an ambient temperature range from -35^{o} F to +165^{o} F while exposed to precipitation as well as direct sunlight.

10. A thermostatically controlled heater must be provided to prevent the formation of ice and condensation, as well as to assure proper operation of the lens's iris mechanism. The heater must not interfere with the operation of the camera electronics, and it must not cause interference with the video signal.

11. The enclosure must be light colored or unfinished and must include a sun shield to minimize solar heating.

12. The enclosure shall allow the camera horizon to be rotated in the field during installation.

13. The system shall operate normally over an input voltage of 90 to 250 VAC at 50 or 60 Hz.

14. Functional Capabilities.

- **a.** The system software must be able to detect either approaching or departing vehicles in multiple traffic lanes. Each zone and output must be user-definable through interactive graphics by placing lines and/or boxes in an image on a video monitor.
- **b.** Detection zones must be provided that are specific to the direction of vehicle travel. The direction to be detected by each detection zone must be user programmable. The vehicle detection zone shall not activate if a vehicle traveling any direction other than the one specified for detection occupies the detection zone. Cross-street and wrong way traffic shall not cause detection.
- **c.** The processor unit must compensate for minor camera movement without falsely detecting vehicles.
- **d.** Power and communications for the video sensor shall be carried over a single three-conductor cable. All communications to the video sensor shall be broadband-over-power via the same three conductor cable that powers the unit. Coaxial cable shall not be required.
- **e.** No supplemental surge suppression shall be required outside the cabinet.
- **f.** The video detection system shall automatically collect and store traffic flow data in non-volatile memory for later retrieval and analysis. No additional hardware or software shall be necessary. The data shall include vehicle counts and vehicle average speeds.

15. Video Detection Requirements.

- **a.** Preferred presence detector configurations shall be boxes placed in the lanes, or boxes placed in-line with lanes of traffic.
- **b.** Detection zones shall have the capability of implementing “AND” and “OR” logical functions including presence, extension, and delay timing.
- **c.** The system shall detect the presence of vehicles in up to ten detection zones per camera.
- **d.** The system shall allow reliable detection of zones placed up to 500 feet from camera.
- **e.** Placement of detection zones shall be by means of a PC with a Windows operating system, a keyboard, and a mouse. The PC monitor shall be able to show the detection zones superimposed on images of traffic scenes.
- **f.** The video detection system shall provide three failsafe options during optical contrast loss. The default shall be maximum recall. The end-user may choose to use minimum recall or fixed recall in which a user-defined number of seconds may be implemented to hold call during “green”.
- **g.** The video detection system shall provide flexible detection zone placement anywhere within the combined field of view of the image sensors.
- **h.** The video sensor shall continuously monitor the overall contrast in the video. If the overall contrast falls below a preset level (such as caused by dirty faceplate, severe glare, extreme fog, or temporary ice/snow on the faceplate), the sensor shall enable the chosen failsafe mode. When sufficient contrast is restored in the video, the sensor will exit the failsafe mode.
- **i.** The communications interface panel shall continuously monitor the connectivity status of the attached video sensors. If any video sensor goes offline due to either electrical failure or internal software failure, the communications interface panel shall enable the failsafe mode for that video sensor. If the video sensor comes back online, failsafe mode shall end.

16. Communication Requirements.

- **a.** The video detection system shall include an interface panel in the traffic cabinet that manages communications between the video sensors, a maintenance technician, and the control cabinet itself.

b. The communications interface panel shall provide connection points for four video sensors.
c. Each sensor connection shall be a 3-pole terminal block, which supplies power and broadband-over-power communications to the sensor.
d. The broadband-over-power communications shall provide a throughput of 70 to 90 Mbps.
e. The broadband-over-power connection shall support at least 1,000 feet of cabling to the video sensor.
f. Each video sensor connection shall include a power switch.
g. Each video sensor connection shall contain a resettable fuse.
h. A wired Ethernet port shall be provided to connect the technician at the cabinet to the video detection system for setup and maintenance purposes.
i. The system shall support 10/100/1000 Mbps Ethernet communication.
j. All communications to the video detection system shall be to a single IP address.
k. An 802.11g Wi-Fi access point shall allow wireless connection to the video detection system at the cabinet for setup and maintenance purposes.
l. All communications to the video detection system through the Wi-Fi access point shall be to a single IP Address.
m. The Wi-Fi access point shall support DHCP to automatically assign an IP Address to the user's computer.
n. The traffic controller connection shall support the NEMA TS2 SDLC protocol to include up to 64 detector outputs and 32 inputs.
o. The traffic controller connection shall be able to connect to a wired input/output card, which supports wired I/O in cabinets without a SDLC-capable controller.
p. The wired I/O data communications link shall support at least 24 outputs and 16 inputs.
q. The communications interface panel and each video sensor shall maintain a time-stamped operations log of routine and special events in non-volatile memory for later retrieval and analysis.

17. Software Requirements.
a. The management software shall automatically determine all video sensors and communications interface panels available on the local network and populate a list of all devices
b. The management software shall provide the user a means to name individual video sensors and communications interface panels.
c. The management software shall provide a means for the user to zoom the camera optics while viewing a live video stream.
d. The management software shall provide a means for the user to calibrate distances in the field of view.
e. The management software shall provide the user a means to create 4-sided detection zones in the field of view using either a still snapshot or live video
f. The management software will overlay an outline of each detection zone over the background image.
g. It shall be possible for the user to place detection zones anywhere in the field of view for stop line detection and/or advance detection.
h. It shall be possible for the user to alter the size and shape of any previously created zone.
i. It shall be possible for the user to overlap zones, either partially or fully.
j. The management software shall be able to download a new version of the application software into a communications interface panel and its attached video sensors.
k. While monitoring the video of a single video sensor or of the quad-view, it shall be possible for the user to record a period of the video to save to a named file on a laptop.

18. Warranty.
a. The video detection system shall be warranted to be free of defects in material and workmanship for a period of 2 years from date of shipment from the supplier's facility.
b. Ongoing software support by the supplier shall include updates of the processor unit

firmware and all remote windows software. These updates shall be provided free of charge during the warranty period.

c. The supplier shall maintain a program for technical support and software updates following expiration of the warranty period.

d. 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 certified personnel or factory certified installers.

J. Foundations, Footings, and Bases.

1. Concrete for foundations, footings, and bases shall be Class “C” structural concrete, C-4 mix.

2. Reinforcement for foundations, footings, and bases shall meet the requirements of Section 2404 of the Standard Specifications.

3. Precast concrete pipe used in constructing pull boxes shall be Type 2000-D.

K. Major Warning Sign Assembly.

The major warning sign assembly consists of all materials and labor required for a fully operational warning sign assembly.

1. 12 inch Amber LED Beacons, Housings, Visors, and Backplates.

a. LED Vehicle Signal Modules shall comply with the latest revision of the “Equipment and Material Standards of the Institute of Transportation Engineers (ITE): Chapter 2a: VTCSH Part 2: Light Emitting Diode (LED) Vehicle Signal Modules” Note the following: Section 5.5 Dimming (Optional) is not required. Section 5.8 Failed State Impedance (Optional) is required. Compliance with all other sections of this standard is required.

b. All beacon equipment and accessories shall be AC-powered and UL listed.

c. Use 12 inch, polycarbonate vehicle signal heads.

d. Fabricate vehicle signal sections, visors, and background shields with ultraviolet and heat stabilized black polycarbonate materials that conform to ITE requirements.

e. Provide and install a metal support plate (supplied by the signal head manufacturer) on the inside of the signal section at the attachment point of the mount (one plate inside the head at the attachment point).

f. Provide and install 12 inch amber LED indications.

g. Each flashing beacon assembly must include a cut away visor and background shield.

h. Backplates shall be 0.125 inch thick thermoplastic and provide a minimum of a 5 inch black field around the assembly. Corners of the backplates shall be rounded with a 2 1/2 inch radius.

i. Backplates shall be supplied with attaching bolts or screws in sufficient quantity to securely hold the backplates to the signal heads.

j. Backplates and visors will be installed with all signal heads, unless otherwise directed by the Engineer.

2. Perforated Square Steel Tube (PSST) Support Posts.

a. Contractor shall furnish and install perforated square steel tube (PSST) posts that meet the Standard Specifications.

b. Each Major Warning Sign Assembly shall have two PSST Supports as shown in the plans.

3. PSST Anchors for Concrete Installations.

a. Unless directed otherwise by the Engineer, furnish and install PSST Anchors in Concrete Bases/Footings as shown in the plans.

b. The Standard Specifications and standard road plans shall be followed.

4. Sign Post Footings

a. Bases and footings shall meet the requirements listed in this special provision.
b. The Standard Specifications and standard road plans shall be followed.

5. Transportation and Installation of DOT-provided sign panels.
a. Collect and transport DOT-provided sign panels for all locations from the Iowa DOT Sign Shop.
b. Contact the Engineer to schedule pick-up of sign panels at least 3 weeks prior to the start of construction.
c. Contractor is responsible for all sign mounting brackets and hardware. Mounting brackets and hardware shall meet all requirements of the Standard Specifications and Standard Road Plans.

6. 1.5 inch Conduit & Couplings/Adapters.
a. Furnish and securely install 1.5 inch conduit to the sign support structure for power to the flashing amber beacons.
b. Use attachment methods as shown in the plans and as approved by the Engineer. The use of dissimilar metals in mounting hardware is prohibited.
c. Contractor may use a flexible, liquid-tight non-metallic conduit - or - a rigid metallic conduit with the approval of the Engineer.
d. All conduit shall be rated for above-ground installations, be UV-resistant, weatherproof, and watertight.

7. Mounting Plates and Hardware.
a. All mounting plates and hardware required to mount sign panels, beacons, and supporting equipment shall be furnished and installed by the Contractor.
b. All hardware shall be stainless steel.

L. Loop Detector.
A loop detector consists of a conductor loop or series of loops installed in the roadway, lead-in (feeder) cable, and a sensor (amplifier) unit with power supply installed in a control cabinet.

1. All materials shall comply with IMSA Specifications 50-2 and 51-5.

2. Loop lead-in cable shall be rated to 600V and have a polyethylene jacket.

3. Use a splice encapsulator to protect the lead-in cable splice to the loop with the following properties:
a. Designed for use in weather-exposed or direct burial locations.
b. For making splices on unshielded synthetic insulated cables.
c. UL Listed for direct burial and submerged applications up to 600 volts.
d. Capable of withstanding temperatures up to 90°C.

4. Use a rapid cure, high viscosity, liquid epoxy sealant formulated for use in sealing inductive wire loops and leads embedded in pavement. Ensure the cured sealer is unaffected by oils, gasoline, grease, acids, and most alkalis.

5. Use a sealant complying with Materials I.M. 491.18

6. Use a sensor unit that is solid state, digital, providing detection channel(s) with an inductance range of 0 to 2000 micro-henries. Output circuits of the sensor unit will be provided by relays. Vehicle presence will result in a continuous call indication.

7. Provide a sensor unit with the following qualities:
a. Sensitivity adjustment to allow as a minimum the selection of high, medium, or low sensitivity.
b. Be capable of providing reliable detection of all motor vehicles.

c. Provide an indicator light for visual indication of each vehicle detection.
d. Will not require external equipment for tuning or adjustment.
e. Provide operation in the pulse mode or presence mode. Ensure mode switch is readily accessible.
f. Provide a self-tuning system that is activated automatically with each application of power. Provide automatic and continuous fine tuning to correct for environmental drift of loop impedance.
g. Provide for fail-safe operation (continuous call) in the event of detector loop failure.
h. Ensure each detector channel will respond to a frequency shift in an increasing or decreasing value as occurs with temperature shifts in the pavement without requiring a locked call.
i. Use detector units with delay and extension timing. The delay feature is selected and adjusted externally on the sensor unit housing. Digitally derived timing is selectable in 1 second increments from 0 to 30 seconds. Ensure delay timing inhibits detector output until presence has been maintained for the time selected. Restart delay timer at each new detection.
j. Use a sensor unit capable of normal operation without interference and false calls between sensor units ("crosstalk") when installed in the physical environment of the controller cabinet and the electrical environment of the associated electronic equipment installed therein, including other detectors.

M. CAT6 Cable.
Provide outdoor use rated Category 6 Ethernet Cable.

150498.02 CONSTRUCTION.

A. General.

1. Stake all pull boxes, sign posts, loops, poles, cabinets, and proposed conduit alignments for approval by the Engineer a minimum of 1 week prior to construction. The Engineer will authorize any changes in location in writing before performing the installation. No additional compensation shall be provided for additional work associated with, or resulting from, unauthorized changes to the contract documents.

2. Notify the Engineer immediately if an obstruction conflicts with a foundation. The Engineer is responsible for relocating or determining another effective means of supporting the structure to eliminate the conflict. Payment shall not be made for re-work or extra work as the result of an unauthorized relocation of a foundation.

B. Control Cabinet and Foundation.

1. General.
a. Furnish and install cabinets and their foundations in accordance with the contract documents and the manufacturer's recommendations.
b. Construct all foundations as located by the Engineer and set level and to the proper elevation. Meet all requirements of the contract documents.
c. Install a sufficient number of conduits sized as indicated in the contract documents. All conduits shall be located as indicated in the contract documents
d. Do not penetrate the top of any cabinets without prior authorization by the Engineer.
e. Do not allow screws used for mounting shelves or other mounting purposes to protrude beyond the outside wall of the cabinet.
f. All exterior connections shall be watertight.

2. Mounting.

a. Orient cabinets as shown in the contract documents unless otherwise directed by the Engineer. Cabinets shall be installed directly next to the existing battery back-up cabinets unless otherwise shown in the plans or directed by the Engineer.
b. Ensure sufficient clamps, nuts, hardware, etc., as required for the specified mounting type, are furnished with each cabinet.
c. Seal all conduit openings in the control cabinet using mechanical duct plugs or as directed by the Engineer.

3. Improper Construction.
Remove and reconstruct, at no additional cost to the Iowa DOT, all cabinets and foundations improperly constructed or with improperly installed anchor bolts, conduit, or any other components as determined by the Engineer.

C. ITS Pole and Foundation.
In addition to any Contractor-provided equipment, furnish and install a pull rope from the top of the ITS pole, through the conduit network, to the proposed control cabinet.

1. General.
a. If pole has structural damage do not erect and notify Engineer.
b. Repair any surface damage to galvanized components using a zinc-rich paint acceptable to the Engineer.

2. Pole Erection.
a. Erect poles (including video detection mounting system and poles) and securely bolt to the foundation base plate such that the pole is vertical to the centerline of the nearest adjacent major roadway.
b. Use leveling nuts on each anchor bolt installed below the pole flange. Adjust the pole's vertical position by adjusting both the upper and lower nuts.

D. Wire and Cable.
Wire requirements as outlined in Section 2525 and Article 4185.12 of the Standard Specifications shall be followed with the added provisions:

1. General.
a. All installations and connections shall comply with the contract documents and all generally accepted codes and standards.
b. Install cable connectors in accordance with contract documents at the base of all breakaway poles, cabinets, or other installations for all non-low voltage installations unless otherwise directed by the Engineer. Cable connectors shall be unfused and listed for the specific application. All costs associated with these connectors are incidental to the cost of the connected items of work.
c. The Engineer shall resolve all conflicts.

2. Tracer Wire.
a. Install, splice, and test for continuity tracer wire in all conduit installations as indicated on the contract documents.
b. Where new tracer wire is installed:
- Splice tracer wire only in pull boxes, cabinets, and pole bases to form a continuous network using splice kits listed for wet locations.
- Test all tracer wire for continuity, with approval by the Engineer, prior to final acceptance.

c. Labeling Requirement.
Tags shall clearly identify where each individual cable run originated and where it ends (pull box to pull box, pull box to cabinet, etc.).

3. Grounding/Bonding.

a. Ground all installations as indicated in the contract documents.
b. Installation of grounds is incidental to the cost of the connected items of work.
c. Ground all installations in accordance with the requirements of NEC. Supply and install additional grounding rods and equipment as necessary to satisfy such requirements at no additional cost to the Contracting Authority.

4. Labeling.
a. Label all cables within one foot of their terminations with the type, origin, and destination of the cable.
b. Labels shall be laminated, weatherproof, and UV-resistant, when possible.

E. Pull Box.

1. Install the type and size of Pull Boxes at the locations indicated in the contract documents.

2. Set top of all Pull Boxes to depths as indicated in the contract documents for different installation locations.

3. Install coarse aggregate bedding below the Pull Box as identified in the contract documents.

4. Conduit shall enter the Pull Box from the bottom and extend conduit ends between 4 and 6 inches above the aggregate bedding.

5. Side penetrations of the Pull Boxes are not permitted.

6. Terminate each tracer wire run at end Pull Box locations and at devices and cabinets.

7. Install ground rods at all Pull Boxes near poles, cabinets, signs, and as indicated in the contract documents.

8. Plug all open conduit ends within the Pull Box with mechanical duct plugs or in a manner acceptable to the Engineer.

9. Rodent proof all Pull Boxes to the satisfaction of the Engineer.

10. Provide a minimum of 5 feet of additional cable at each pull box and loosely coil the extra cable on the pull box cable hooks.

F. Conduit.
The Contractor may choose the method of conduit installation within the requirements listed below and in the contract documents or as directed by the Engineer.

1. General.

a. Follow all general guidelines covering the construction of buried conduit.
b. Install conduit by plowing, jacking, pushing, boring, or other approved methods within the public right-of-way and in a manner that minimizes atypical damage from construction operations.
c. The minimum bending radius of HDPE conduit shall be the larger of 20 times the outside diameter or the HDPE manufacturer's recommendations for minimum bending radius.
d. Open trench installation is only permitted within 25 feet of any pull box, pole, structure, or other similar improvements, and any other requested locations approved by the Engineer.
e. At the discretion of the Engineer, verify the integrity of the conduit structure in a manner acceptable to the Engineer.
f. Tunneling under the pavement or water jetting shall not be permitted.

g. No excavations are permitted to cross any roadways or any other paved or other similarly improved areas. At these locations, install conduits by boring method unless otherwise directed or approved in writing by the Engineer. Where indicated in the contract documents and at all roadway and stream crossings, install conduit sections with external protection as specified herein.
h. No direct-buried cable is allowed.
i. Unless otherwise indicated in the contract documents, installation of Schedule 40 PVC conduit or approved alternative is allowed only when approved by the Engineer.
j. Seal all conduit openings using watertight mechanical duct plugs, or as directed by the Engineer, at all conduit openings at the junction boxes, pull boxes, ITS poles, and control cabinets.
k. Thread and cap all rigid steel conduit ends with standard conduit caps until wiring is installed. Before wiring is installed, replace caps with threaded insulating bushing in accordance with Article 2523.03, N of the Standard Specifications.

2. Installation Clearances.
a. Depth of all bores shall be a minimum of 48 inches unless otherwise specified in the plans.
b. Maintain the typical offsets from referenced locations as shown in the plans.
c. Maintain the minimum depth throughout the length of all conduit installations.
d. Maintain a minimum of 2 feet of separation when underground conduits parallel an existing facility.
e. Maintain a minimum of 2 feet vertical separation when crossing existing utilities.

3. Conduit Splicing.
a. Conduit shall be installed with minimal splices between pull boxes, foundations, and structures as shown on contract documents.
b. All mechanically joined conduit splices shall use compression couplings designed for underground placement and blown-in fiber installation.
c. Butt fusion welding and solvent welding of conduits will not be allowed.
d. All conduit splices shall be designed to be watertight to 200 psi.
e. Conduit splicing is incidental to the connected items of work.

4. Facilities Protection.
a. The Contractor is responsible for protecting and maintaining the conduit throughout construction and until final acceptance.
b. To avoid possible damage to buried conduit from exposure to traffic, livestock and other hazards, complete trenching of laterals, trenching around culverts, construction of aerial inserts and similar operations as soon as practicable behind all segment installations.
c. If more than 48 hours lag is expected behind a segment installation, install additional protective measures acceptable to the Engineer.

5. Backfilling.
a. Backfill trenches and other excavations in lifts of 6 inches or less in compacted depth. Compact each layer thoroughly before placing subsequent layers.
b. Remove all cinders, broken concrete, or other hard or abrasive materials in the backfill material before commencing backfilling operations.
c. Remove and dispose of surplus and unsuitable materials upon completion of the backfilling operations in the area.
d. Place and carefully hand tamp backfill under and around the structures in lifts not to exceed 4 inches in loose thickness. Use a suitably sized mechanical tamper for all areas inaccessible to rollers.
e. Perform operations in a manner that minimizes soil erosion and employs appropriate storm water pollution prevention measures during all construction operations.
f. Maintain work areas in a neat, clean, and orderly condition at all times.

g. Upon completion of conduit/cable placing operations and any other work in an area, remove all debris, materials, tools, and equipment from the area and restore the disturbed area(s) to original or better condition within 24 hours or as soon as practicable as determined by the Engineer. Backfill all excavations and grade all disturbed areas during the restoration process.

h. Remove and dispose of rock and debris excavated and remaining after backfilling as directed by the Engineer.

6. Surface Restoration.

a. Replace or reconstruct features removed as a part of the work, such as sidewalks, driveways, curbs, roadway pavement, unpaved areas, or any other items.

b. Immediately repair or replace any unauthorized disturbance or damage. Replace improved landscaping, lawns, scrubs, and hedge removed or damaged during construction in a manner acceptable to the Engineer. Re-sod damaged lawns using like grasses.

c. Complete restoration according the applicable sections of the Standard Specifications.

7. Multiple Duct Installation.

Install multiple ducts, in continuity, at locations indicated in the contract documents unless authorized in writing by the Engineer.

8. Plowing.

a. Use equipment and construction methods subject to the approval of the Engineer that cause minimal displacement of the soil.

b. Furnish competent supervision at all times at the site of plowing operations to assure compliance with the contract documents.

c. The equipment shall be capable of extending the plow in order to maintain the required minimum depths under all terrain conditions.

d. The reel carrier shall be of adequate size and be configured so that the reel sizes being used can be safely handled.

e. Avoid damaging any paved surfaces, ditches, or other similar surface features.

f. Immediately repair any damage to such features to the satisfaction of the Engineer.

g. Perform plowing in accordance with standard industry practices using a prime mover with hydrostatic type steering and a vibratory plow. The design of the plowshare shall be such that the buried conduit passing through the plow shall not bind and shall not be bent in a radius less than 20 times the outside diameter of the conduit and maintains the structural integrity of the conduit. The feed chute shall have a removable gate for the purpose of inspection and to allow the conduit to be removed from or inserted into the feed chute at any intermediate point between splice locations. The conduit path inside the feed chute shall have low friction surfaces and be free of burrs and sharp edges to prevent damage to the conduit as it passes through. Smooth any welds before use. Internal guide rollers shall not be used. Exercise care during the plowing operation to avoid conduit damage. Feed the conduit into the ground through the plow loose and at no tension.

h. Excavate as needed start and finish pits and pits at points of intersection in advance of plowing. Expose ends of casings and crossings of foreign utilities before the start of plowing operations for a conduit segment. Exercise care in the use of trenching and excavating tools and equipment to avoid damaging installed and intersecting conduits or other facilities.

i. Restore plow furrowed areas to conform to the surrounding terrain using a rubber-tired tractor or heavy truck or a vibratory roller having a weight of 3 tons and a drum width between 4 and 6 feet or by other suitable means approved by the Engineer.

9. Conduit in Trench.

a. Use equipment and construction methods subject to the approval of the Engineer that cause minimal displacement of the soil.

b. Excavate open trench straight as practicable. Shape the trench to be smooth, free from any sharp edges, and clear of debris and loose rock. Excavate only gradual grade changes.
c. Do not leave trenches unattended at any time or open during non-working hours unless approved in writing by the Engineer. Install barriers or other protective measures to prevent livestock or persons from falling into an open trench when appropriate.
d. Notify the Engineer immediately if solid rock is encountered at any location. Excavate rock trenches using a rock saw or other suitable equipment. The excavation, backfill, and road crossings in solid rock areas shall conform to the requirements stated above unless specifically exempted in this section.
e. Rock excavation shall be considered extra work and shall be paid as a separate cost item. Obtain approval from the Engineer before commencing any rock excavation.

10. Bored Crossings.
a. Use equipment and construction methods subject to the approval of the Engineer that cause minimal displacement of the soil.
b. Bore all crossings beneath roadways, streets, other paved surfaces, railroads, or other structure in accordance with requirements and regulations of the authority having jurisdiction and as directed in the contract documents.
c. Limit bore hole sizes to the outside diameter of the conduit being placed.
d. Locate bore pits a minimum of 2 feet from the edge of pavement or shoulder unless otherwise directed by the Engineer.

G. Power Connections.

1. Install power connections in accordance with the contract documents, NEC, and all requirements of local electrical utility.

2. Coordinate installations in advance as noted on the contract documents.

3. Provide all conduit, breaker enclosures, circuit breakers, wiring and accessories, neutral bars and accessories, ground bars and accessories, terminations and grounding when connecting to the existing battery backup power source.

4. Unless otherwise directed by the Engineer, install the power connections as illustrated in the contract documents.

5. The Contractor is responsible for furnishing and installing any hardware necessary to ensure both the existing and proposed (new) ICWS systems can operate simultaneously from the existing battery back-up power supply cabinet.

H. LED Sign Lights.

1. Examination.
a. Verify that field measurements are as shown on the plans.
b. Verify that conditions are satisfactory for installation prior to starting work.

2. Installation.
a. Install products according to manufacturer's instructions.
b. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 1 (general workmanship) and NECA/IESNA 501 (exterior lighting).
c. Install luminaires aligned with sign pole and center of sign.
d. Install all accessories furnished with each luminaire.
e. Bond products and metal accessories to branch circuit equipment grounding conductor.
f. LED Sign Lights shall operate on a photo cell-controlled circuit. Lights shall only operate in dark conditions.

3. **Field Quality Control.**
   - **a.** Inspect each product for damage and defects.
   - **b.** Operate each luminaire after installation and connection to verify proper operation.
   - **c.** Correct wiring deficiencies and repair or replace damaged or defective products.
   - **d.** Repair or replace excessively noisy power supplies as determined by Engineer.

4. **Adjustment.**
   - **a.** Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by thee Engineer. Secure locking fittings in place.
   - **b.** Aim and position adjustable luminaires to avoid interference of mounted beacons or cameras as directed by the Engineer.

5. **Cleaning.**
   Clean surfaces according to NECA/IESNA 501 and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

6. **Protection.**
   Protect installed luminaires from subsequent construction operations.

I. Video Detection.

1. Contractor is responsible for the materials and equipment necessary to mount and operate the video detection system.

2. The video detection system shall be constructed, mounted, and installed per the manufacturer’s recommendations.

3. Use camera cable(s) meeting the manufacturer’s recommendations and these specifications. Provide a continuous run, without splices, from the camera to the control cabinet.

4. Make connections between the video detection processor / communications manager to the ICWS system relays and detection cards.

5. The Contractor is responsible for the seamless integration of the video detection system with the full ICWS system.

6. Contractor shall provide the integration software to the Iowa DOT upon request.

7. The Contractor shall program the video detection system to detect the presence of a variety of vehicles types, vehicle speeds, and vehicle driving patterns within the detection zones. The video detection settings shall be adjusted in an iterative fashion until optimal detection performance is achieved.

8. When detection settings are complete, the Contractor shall schedule a field test in the presence of the Engineer to demonstrate the detection system meets the stated detection accuracy requirements. Testing will be done at each of the project sites.

9. The video detection settings shall be adjusted as necessary, and additional tests conducted, until the system meets the stated accuracy requirements.

J. Foundations, Footings, and Bases.

1. Each foundation or base location shall be approved by the Engineer prior to construction. Base dimensions shown on the plans are minimum dimensions and based on stable soil conditions. Should extremely loose or sandy soil be encountered, the Contractor shall contact the Engineer for necessary alterations.

2. All forms used for the construction of the foundations and bases shall be removed after the appropriate amount of cure time.

3. Excavations for foundations and bases shall be made in a neat and workmanlike manner. Whenever the excavation is irregular, forms shall be used to provide the proper dimensions of the foundations below grade. Construction of the bases may require hand excavation to verify location of utilities.

4. All reinforcing bars, conduits, ground rods, and anchor bolts shall be installed rigidly in place before concrete is placed in the forms. Cap and protect conduit ends before placing concrete

5. The top of the base shall be finished level and the top edges shall be rounded with an edge having a radius of 1/2 inch. The exposed surface of the base shall have a wood floated surface finish. Exposed concrete surfaces shall be cured using white-pigmented curing compound or plastic film meeting the requirements of the Standard Specifications.

6. After the concrete is placed in the form, it shall be vibrated with a high-frequency vibrator to eliminate all voids.

7. After the foundation or base has been poured, absolutely no modification of any sort may be made. If the anchor bolts, conduit, or any part of the foundation or base is installed in an incorrect manner as determined by the Engineer, the entire foundation or base shall be removed and a new foundation or base installed. The Contractor shall bear all costs of replacing work deemed unsatisfactory by the Engineer.

8. Prior to setting poles or cabinets, the anchor bolts shall be covered in such a manner as to protect them against damage and to protect the public from possible injury.

K. Major Warning Sign Assembly.

1. Install Major Warning Sign Assemblies per the Iowa DOT Standard Road Plans and Specifications.

2. Affix to the back of each yellow flasher indication a permanent label indicating the date of installation to the satisfaction of the Engineer.

3. Attach flasher beacons to the Major Warning Sign Assembly as detailed in the Plans to the satisfaction of the Engineer.

4. Install PSST Supports, Anchors, and Footings per the Standard Road Plans and Specifications.

L. Loop Detector.

1. Coordinate the location of the detector loop with the Engineer. Obtain the Engineer's approval prior to cutting the pavement.

2. Saw to ensure proper depth and alignment of the slot. Make a 2 inch deep clean, straight, well-defined 3/8 inch wide saw cut without damage to adjacent areas. Overlap the saw cuts where the detector loop changes direction to provide full depth at all corners. Do not use right angle or corners less than 90 degrees.

3. Before installing the detector loop cable, check the saw cuts for the presence of jagged edges or protrusions and remove if present. Clean and dry the saw cuts to remove cutting dust, grit, oil, moisture, or other contaminants. Clean by flushing with a stream of water under pressure. Use oil-free compressed air to dry the saw cuts.

4. Install detector loop cable without damage. Place three turns of the detector loop cable into the saw cut. Seal the ends of the tubing at the time of placement to prevent entrance of moisture.

5. Ensure the detector loop cables are in the bottom of the saw cut. Place detector loop sealant within the saw cut area. Comply with the manufacturer's instructions for mixing and using the detector loop sealant.

6. Identify each detector loop cable in the nearest pull box by name and location. Wind loops that are physically adjacent in an individual lane or adjacent lanes with opposite rotation (i.e. No. 1 clockwise, No. 2 counter-clockwise, No. 3 clockwise, etc.). Rotation reversal can be accomplished by reversing leads at the pull box.

7. Twist, with at least five turns per foot, all lengths of loop wires and tubing that are not embedded in the pavement.

8. Identify all detector loop lead-in cables with appropriate detector numbers.

9. Use a detector loop cable splice kit for the electrical splice between the detector loop cable and the detector loop lead-in cable to the control cabinet.

10. Ensure splice kit provides a watertight protective covering for the spliced wire, the shielding on the detector loop lead-in cable, and the end of the tubing containing the detector loop cable.

11. Use a manufactured electrical splice kit approved by the Engineer.

12. Test all loops and document by using the following procedures:
    a. Determine the insulation resistance of the loop wire using a "megger" with 500V applied to either loop wire to earth ground. The resistance is to be greater than 100 megohms.
    b. Determine the inductance of the loop using a loop inductance meter.

M. Removal of Sign.

1. Removal of Sign shall include the removal of existing sign panels, support structures, support footings, flashing beacon assemblies, and other ancillary hardware at the locations identified in the plans.

2. Contractor is responsible for the complete removal of all sign materials from the locations identified on the plan. The Engineer will identify any material which he or she will collect as salvageable for the Iowa DOT. All other equipment and material shall be disposed of by the Contractor.

N. Removal of CCTV Pole.

1. Removal of CCTV Pole shall include the removal of the inplace CCTV pole, pole footings and foundations, pole-mounted cabinets and hardware, Iowa DOT CCTV cameras, equipment, and hardware, and other ancillary hardware at the locations identified in the plans.

2. Contractor shall salvage the CCTV cameras, equipment, and hardware to the Engineer. The Engineer will identify any other material which he or she will collect as salvageable for the Iowa DOT. All other equipment and material shall be disposed of by the Contractor.

3. Contact the Engineer a minimum of 7 days prior to the removal of inplace CCTV Poles and equipment for salvageable material coordination.

O. CAT6 Cable.

1. Terminate both ends of cable with approved connectors.

2. Provide 10 feet of slack cable at all device connections.

3. Label all cables within one foot of their terminations with the type, origin, and destination of the cable.

150498.04 METHOD OF MEASUREMENT.

A. Control Cabinet and Foundation.
Measurement and payment for control cabinet & foundation shall be at the contract unit price per each for the item Control Cabinet & Foundation.

B. ITS Pole and Foundation.
Measurement and payment for all ITS poles, bases, and foundations shall be at the contract unit price per each for the item ITS Pole and Foundation.

C. Wire and Cable.

1. Measurement and payment for all wire and cable shall be at the contract unit price per linear foot for the items 2/C No. 14 AWG Cable (Det), 3/C No. 12 AWG Cable (Sign Lights), 3/C No. 18 AWG Cable (Video Detection), and 4/C No. 12 AWG Cable (Sign).

2. Tracer wire and grounding wire shall be incidental to the conduit bid items at the contract unit price per linear foot for the items: 2 inch Conduit and 3 inch Conduit.

D. Pull Box.
Measurement and payment for all Pull Boxes shall be at the contract unit price per each for the item Pull Box.

E. Conduit.

1. Measurement and payment for all conduit shall be at the contract unit price per linear foot for the items 2 inch Conduit and 3 inch Conduit. Contractor may decide the best method of conduit installation within the requirements of these provisions and pending approval by the Engineer.

2. Conduit length is calculated from plan dimensions as the linear, one-way length of new conduits. No allowance has been added to this quantity.

F. Power Connections.
Measurement and payment for all power connections shall be incidental to the bid item: Control Cabinet & Foundation.

G. LED Sign Lights.
Measurement and payment for all luminaire items, accessories, mounting hardware, and direct cabling shall be at the contract unit price per each for the item LED Sign Lights.

H. Video Detection.
Measurement and payment for all video detection system items, accessories, mounting hardware, software, warranties, and direct cabling shall be at the contract unit price of lump sum per site for the item Video Detection.

I. Foundations, Footings, and Bases.
Measurement and payment for each base or foundation item shall be per each and included in the bid item that the foundation or base is supporting. For example, the foundation for an ITS Pole would be included in the 'ITS Pole and Foundation' bid item.

J. Major Warning Sign Assembly.
Measurement and payment for Major Warning Sign Assembly, including: 12 inch Amber LED Beacons, Housings, Visors, and Backplates, Perforated Square Steel Tube (PSST) Support Posts, PSST Anchors for Concrete Installations, Sign Post Footings, Transportation and Installation of DOT-provided sign panels, 1.5 inch flexible liquid-tight non-metallic or rigid metallic conduit & couplings/adapters, and all mounting plates and hardware required to mount sign panels, beacons, supporting equipment, and direct cabling shall be at the contract unit price per each for the item Major Warning Sign Assembly.

K. Loop Detector.
Measurement and payment for all Loop Detectors shall be at the contract unit price per each for the item Loop Detector.

L. Removal of Sign.
Measurement and payment for all Sign Removals, including all the materials and equipment listed in the plans and these provisions, shall be at the contract unit price per each for the item Removal of Sign.

M. Removal of CCTV Pole.
Measurement and payment for all CCTV Pole Removals, including all the materials and equipment listed in the plans and these provisions, shall be at the contract unit price per each for the item Removal of CCTV Pole.

N. CAT6 Cable.
Measurement and payment for all CAT6 Ethernet Cable shall be at the contract unit price per linear foot for the item CAT6 Cable.

150498.05 BASIS OF PAYMENT.

A. Control Cabinet and Foundation.
Payment is full compensation for:

1. The furnishing and installation of all cabinets and their foundations, including all surface excavations, repair or restoration of any nearby areas.

2. Including all internal components and accessories required to provide a complete cabinet installation and operational ICWS system per the contract documents,

3. Power connections between the proposed ICWS system and the existing battery backup system,

4. Final System Acceptance testing at each site with the Iowa DOT and Engineer,

5. Providing and installing all mounting materials, cable pulling, routing and management, cable termination, and all necessary electric grounding materials, and

6. Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

B. ITS Pole and Foundation.
Payment is full compensation for:

1. Installing a pull rope from the proposed control cabinet, through the conduit system to the top of the ITS pole,

2. Designing, furnishing, and installing a foundation for the ITS pole,

3. The installation of all poles, bases, foundations, and accessories,

4. Including all conduit entrances and attachments, all necessary electric grounding materials, and

5. Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

C. Wire and Cable.
Payment is full compensation for:

1. The furnishing and installation of all wire and cable,

2. Including the proper installation of the wire and cable into existing conduit and new conduit systems, supply and installation of splices and connectors, labels, and slack, coiled, or stored wire or cables, and

3. Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

4. Prior to final acceptance, the Contractor shall meet with the Engineer to demonstrate the locate system is working properly throughout the entire locate system.

D. Pull Box.
Payment is full compensation for:

1. The furnishing and installation of all Pull Boxes,

2. Including all surface excavations, repair or restoration of any nearby areas, concrete, proper water/moisture drainage materials, all necessary electric grounding materials and installation,

3. Furnishing and installing all ground rods at pull boxes, and

4. Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

E. Conduit.
Payment is full compensation for:

1. The furnishing and installation of all conduits per the contract documents,

2. Including all surface excavations or surface preparation work, repair or restoration of any disturbed areas to pre-construction conditions, proper water/moisture drainage materials,

3. Also including all tracer and grounding wire to complete a full locate system in the underground conduit infrastructure installed,

4. Conduit mounting on new or existing infrastructure, and

5. Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

F. Power Connections.
Payment is full compensation for:

1. The furnishing and installation of all power connection accessories as shown in the contract documents,

2. Including the proper installation of the conduit, breaker enclosures, circuit breakers, wiring and accessories, neutral bars and accessories, ground bars and accessories, terminations, and grounding required to connect the new Control Cabinet and ICWS system to the existing battery back-up power supply cabinet, and

3. Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

G. LED Sign Lights.
Payment is full compensation for:

1. Furnishing and installation of all luminaires and luminaire accessories as shown in the contract documents,

2. Including the proper installation of the luminaire, luminaire visor, luminaire slip fitting, mounting hardware, power connections, and power cables and,

3. Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

H. Video Detection.
Payment is full compensation for:

9. Furnishing and installation of all video detection system hardware, equipment, software, mounting equipment, direct cabling, and accessories as shown in the contract documents,

10. Including the proper installation, integration, and testing of the video detection system, including all cable connections and configuration necessary in the system software to allow the system to operate the ICWS system as described in the contract documents and,

11. Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents

I. Foundations, Footings, and Bases.
Payment is full compensation for furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents

J. Major Warning Sign Assembly.
Payment is full compensation for:

1. Furnishing and installation of all items listed in the plans and these provisions for Major Warning Sign Assembly as shown in the contract documents,

2. Including the proper installation of the Major Warning Sign Assembly, including all hardware and equipment, mounting hardware, power connections, and cables and,

3. Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

K. Loop Detector.
Payment is full compensation for:

1. The furnishing and installation of all Loop Detectors,

2. Including all saw-cutting, loop wires, epoxy and pavement repair materials, loop splices, loop splice encapsulators, loop sensor units, detection cards, and any ancillary hardware or equipment, and

3. Furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

L. Removal of Sign.
Payment is full compensation for furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents.

M. Removal of CCTV Pole.
Payment is full compensation for furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents

N. CAT6 Cable.
Payment is full compensation for furnishing all materials, labor, equipment, and other incidental items necessary to meet the requirements of the contract documents

PART III

ADDITIONAL BIDDING ATTACHMENTS

Equipment and Materials List for Submittal Requirements.

DESCRIPTION	MANUFACTURER	CATALOG NUMBER
CONTROL CABINET		
CONTROL CABINET EQUIPMENT		
SURGE PROTECTOR		
ITS POLES AND FOUNDATIONS		
2/C #14 AWG CABLE (LOOP)		
3/C #12 AWG CABLE (SIGN LIGHT)		
3/C #18 AWG CABLE (VIDEO DETECTION)		
4/C #12 AWG CABLE (SIGN)		
1/C #10 AWG TRACER WIRE		
PULL BOXES		
2” CONDUIT		
3” CONDUIT		
CONDUIT COUPLINGS		
POWER CONNECTION EQUIPMENT		
LED SIGN LIGHTS		
VIDEO DETECTION		
MAJOR WARNING SIGN ASSEMBLY		
12” AMBER LED BEACONS		
BEACON HOUSINGS		
BEACON VISORS		
BEACON BACKPLATES		
PERFORATED SQUARE STEEL TUBE (PSST) POSTS		
PSST ANCHORS		
SIGN INSTALLATION HARDWARE		
1.5” FLEXIBLE LIQUIDTIGHT NON-METALLIC CONDUIT		
(OR) 1.5” RIGID METALLIC CONDUIT		
LOOP DETECTOR CABLE		
LOOP SPLICE ENCAPSULATOR		
EPOXY SEALANT		
LOOP SENSOR UNITS		
CAT6 ETHERNET CABLE		