SP-230060
(New)

SPECIAL PROVISIONS
FOR
TRAFFIC SIGNALIZATION

Pottawattamie County
IM-080-1(541)5--13-78

Effective Date
November 21, 2023

THE STANDARD SPECIFICATIONS, SERIES 20235, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

230060.01 DESCRIPTION.

A. This special provision describes various materials, equipment, and procedures for operation, modification, maintenance, and removal of temporary traffic signals previously installed on the (511) traffic signal package and for complete installation of permanent traffic signals for the project.

B. This special provision amends Sections 2525 and 2528 of the Standard Specifications.

230060.02 CONSTRUCTION AND MATERIALS.

A. Pedestrian Detection System.
The pedestrian detection system shall be: POLARA iN2 – iNavigator 2 wire push button stations with the POLARA iCCU-S – iNtelligent Central Control unit or most current model. Equivalent pedestrian detection systems may also be approved by the Engineer.

B. Grounding System.

1. An equipment grounding conductor (EGC) shall be installed to electrically bond together all non-current carrying conductive materials, including cabinets, poles, pull boxes and raceways, to form an effective ground-fault current path to the overcurrent protective device (breaker) at the service location, as per NEC section 250.4(A)(5). The earth shall not be used as the sole equipment grounding conductor or effective ground-fault path. The EGC shall be electrically isolated from A.C. Neutral in the controller cabinet.

2. The EGC shall be copper XHHW insulated wire sized per NEC section 250.122. Stainless steel fasteners and copper compression lugs shall be used. Use a specification grade bonding bushings, with stainless steel and hot dip galvanized construction. Use a listed copper

conductive compound on all threads and conductors.

3. The grounding system at the service disconnect shall consist of four 5/8 inch by 10 foot copper clad ground rods placed 15 feet in opposite directions away from the utility pole. The ground rods shall be connected using connectors to No. 2/0 copper cable. Bolt type clamps shall not be used. A common No. 2/0 copper cable may be connected into the disconnect equipment with the four cables being spliced at the base of the pole.

4. The Controller cabinet shall be grounded via a No. 6 copper wire to a 5/8 inch by 10 foot copper clad ground rod located in a handhole a minimum distance of 15 feet away from the Controller cabinet. No ground rods may be installed within the cabinet.

5. A 5/8 inch by 10 foot copper clad ground rod shall be installed at each lighting standard and traffic signal pole. These rods shall be bonded to the EGC. The rod shall be offset below grade to extend into earth and be centered in base in top end of concrete and extend approximately 6 inches above concrete.

6. All loop detector lead-in cables shall have the drain shield wire grounded at the point where the loop wires are connected to the lead-in cables. The drain shield wire shall be removed and covered at the cabinet. The loop lead-in grounding system shall not be connected to or come in contact with any portion of the remainder of the AC grounding system.

C. Contractor Coordination.

The Contractor is required to coordinate with the various utilities in order to obtain clearances required for the installation of conduit and other accessories required to install the complete signal system. All costs incurred in the obtaining of space, marking, defining and coordination are considered incidental to the installation of the signal.

D. Guarantee.

1. The equipment furnished under this specification shall be new, of the latest model, fabricated in a first-class workmanship manner from good quality material.

2. The Contracting Authority shall be furnished with a certification from the equipment manufacturer stating that the equipment furnished under this specification complies with all provisions of this specification. If there are any items, which do not comply with this specification, then a list of those exceptions must be detailed on the certification and on the equipment submittals for the project. Failure to submit a list of exceptions on either the equipment submittals or the certification shall be deemed to be compliance with all issued specifications. Should deviations from the specification be determined from either the review of the equipment submittals or the installation of the hardware into the complete system, the Contractor shall be provided 30 days to correct the deviation(s) before rejection of the project and removal of the equipment.

E. Traffic Signal Heads

1. **Vehicular Signal Heads.**
   - **a.** All vehicular signal heads shall be constructed with 12 inch diameter lens openings. All components of the vehicular signal heads furnished under this specification shall comply with the latest version of the ITE Standard(s) for Adjustable Face Vehicle Traffic Control Signal Heads.
   - **b.** Lenses shall be 12 inches in diameter and shall be polycarbonate. Glass lenses are not acceptable. The lenses shall have an optimal curvature to allow maximization of heat dissipation within the signal (reflector to lens) and reduce the possibility of lens burning.
   - **c.** Visors shall be cap type and at least 9 1/2 inches long. Reflectors shall be Alzak treated

aluminum or glass. All external signal hardware and fasteners of the signal shall be stainless steel, including hinge pins and latching mechanisms.

d. The optical unit of the signal shall be of a design to permit the opening of the signal face for relamping of the signal without the removal of the lamp socket from the reflector assembly.

e. The color of all polycarbonate signal heads, except door fronts and inside and outside of visors, shall be federal yellow. Door fronts and inside and outside of visors shall be black in their entirety. The color of the material shall be an integral part of the materials composition.

f. All signal head assemblies shall be rigid mounted utilizing a suitable assembly consisting of both top and bottom brackets assemblies shall be aluminum.

g. Side of pole signal mounting hardware shall be polycarbonate yellow saddle brackets. Brackets shall be secured to the pole by using minimum 5/8 inch wide stainless steel banding material

h. All signal heads placed on mast arms shall be provided with backplates. Backplates shall be of 5 inch borders and be attached to the signal heads in accordance to city standards. Backplates shall be constructed of one-piece vacuum formed durable black plastic capable of withstanding a 100 mph wind, excluding five section signal displays. The outer edge of the backplate shall utilize a stabilizer formed from the same material as the backplate. The backplates shall be attached to the signal heads utilizing appropriate machine screws, fender washers and locking nuts as per details.

i. All vehicle signal indications (red, yellow and green) shall be LED 12 inch display or an approved equal. The unit shall be mounted and appear as a normal indication within the signal head. All standard arrows shall utilize LED technology signal displays.

j. All LED Ball Signal Modules shall be fully compliant to the ITE VTCSH LED Circular Supplement specifications dated and adopted June 27, 2005.

k. All LED Arrow Signal Modules shall be fully compliant to the “Omni-directional” specifications of the ITE VTCSH -LED Vehicle Arrow Traffic Signal Supplement adopted July 1, 2007.

l. The on-board circuitry of all LED traffic signal modules shall include voltage surge protection, to withstand high-repetition noise transients and low-repetition high-energy transients as stated in Section 2.1.8, NEMA Standard TS 2-2003. In addition, the module shall comply with the following standards: IEC 1000-4-5 at 3kV with a 2 ohm source impedance, ANSI/IEEE C62, 41-2002; IEC 61000-4-12 (6kV, 200A, 100kHz ring wave).

2. Pedestrian Signal Heads.

a. Overview.

1) Purpose.

The purpose of this specification is to provide the minimum performance requirements for a 16 by 18 LED pedestrian signal module with a countdown timer (hereafter called module) with “walking person”, “upraised hand”, and “countdown digit” icons. This specification refers to definitions and practices described in Pedestrian Traffic Control Signal Indicators - Light Emitting Diode (LED) Signal Modules Version August 04, 2010 and the 2009 MUTCD and contains additional requirements to ensure optimum long term reliability and performance. Product supplied to this specification shall comply with the latest version of the ITE PTCSI LED signal specification and the additional requirements listed herein.

2) Manufacturers Requirements and Approvals.

a) Manufacturers supplying products to this specification must be a registered participant and have the part numbers being provided listed on the Intertek-ETL LED Traffic Signal Modules Certification Program approved products website. Products shall be manufactured in a facility certified to the Intertek-ETL program requirements.

b) Must be fully compliant to the ITE PTCSI LED Spec Version Aug 4, 2010. In addition the product must also meet the additional specifications and requirements outlined in the sections below.

b. Physical and Mechanical Requirements.

1) General.

Installation requirements: Installation of a module into existing pedestrian signal housings shall only require the removal of the existing optical unit components, i.e., lens, lamp module, gaskets, and reflector; shall be weather tight and fit securely in the housing; and shall connect directly to existing electrical wiring. Installation shall not require special tools.

2) LED Signal Module.

a) The lens shall have a textured outer surface to reduce glare. No screws shall be used to attach the lens to the housing.

b) Hand, Person, or Digit icons that are not illuminated shall not be readily visible to the pedestrian at the far end of the crosswalk that the pedestrian signal head indication controls. The agency reserves the right to accept or reject the unit based on the physical appearance of the unit at their sole discretion.

c) All icons and numbers shall have a uniform incandescent, non-pixilated appearance.

d) All LED utilized to illuminate the Hand and Person icons, shall be LED that have been manufactured utilizing materials that have industry acceptance as being suitable for uses in outdoor applications.

e) The countdown signal shall display the time remaining in seconds, beginning with the start of the pedestrian clearance interval and ending at the end of the pedestrian clearance interval. Countdown displays should not be used during the walk interval. Upon termination of the countdown sequence the countdown shall remain blank until the beginning of the next pedestrian change interval.

f) The countdown shall be capable of counting down from 99 to 0. There shall be no leading zeroes for numbers less than 10. The display of the “1” digit in the tens position shall be in the right hand portion of the digit.

g) The configurations of the walking person icon, upraised hand icon and countdown digits are illustrated in Figure 1, Figure 2, and Figure 3 respectively.

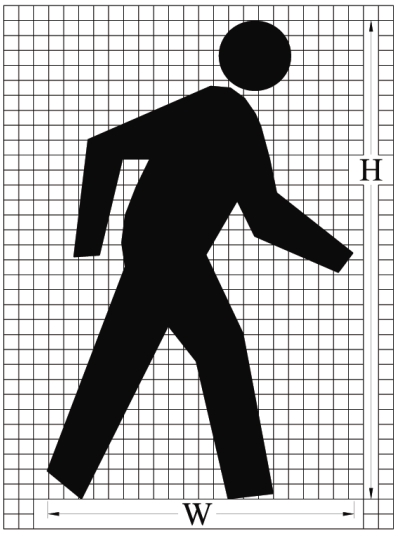

Figure 1—Walking Person icon

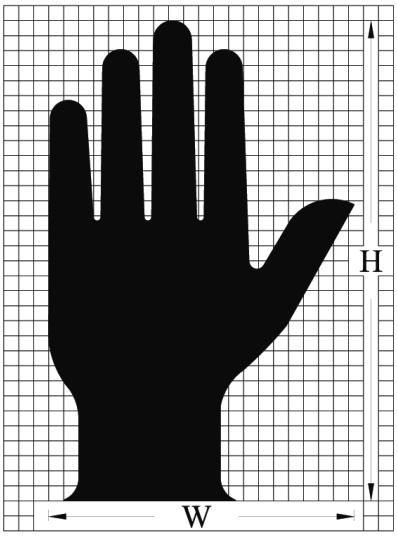

Figure 2— Upraised Hand icon

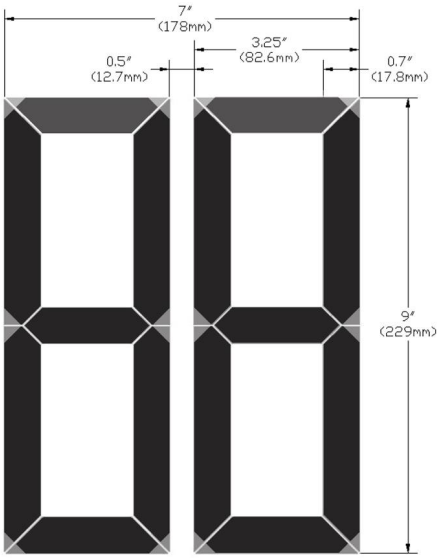

Figure 3—Countdown Display

3) Module Identification.
In addition to the labeling requirements of the ITE specification, all modules must be labeled with the ETL Verified label shown in Figure 4. This label designates the compliance and listing with the Intertek-ETL Traffic Signal Certification Program.

c. Electrical.

1) The following color scheme shall be used for the module's AC power leads: Orange for the upraised hand, Blue for the walking person, and White for common.

2) The AC power leads shall exit the module via a rubber grommetted strain relief, and shall be terminated with insulated female quick connect terminals with spade / tab adapters. The leads shall be separate at the point at which they leave the module.

3) All external wiring utilized in the modules shall be anti-capillary type wire to prevent the wicking of moisture to the interior of the module.

4) In order to minimize the possibility of the incorrect icon being illuminated, the Hand, Person, and Countdown Icons shall utilize three separate power supplies. The countdown module shall be internally wired to the incoming AC power from the hand / person AC signal lines. All power supplies shall be located inside the signal module.

5) All power supplies shall be conformal coated for additional protection.

6) Typical Power at 77ºF for the Pedestrian Signal Modules shall be 11 watts for the hand, 10 watts for the person and 8 watts for the digits when the number "88" is displayed.

d. Countdown Module.

1) Countdown Drive Circuitry.

a) The countdown portion of the signal shall have a high off-state input impedance so as not to provide a load indication to conflict monitors and interfere with the monitoring of the pedestrian signal. The input impedance of the countdown circuitry shall be sufficiently high enough to allow for up to eight units connected on the same channel.

b) It shall be impossible for the display to countdown during a solid Hand indication.

2) Countdown Functionality.

a) Per MUTCD Manual 2009 edition, "Countdown displays should ONLY be used during the "Clearance Cycle". They should NOT be used during the walk interval or during the yellow change interval of a concurrent vehicular phase". A countdown pedestrian signal is required for all crossing with a pedestrian clearance interval of 7 seconds or greater.

b) The countdown timer module shall have a micro-processor capable of recording the pedestrian crossing timing when connected to a traffic controller. It shall be

capable of displaying the digits 0 through 99.

c) When connected, the module shall blank out the display during the one learning cycle only while it records the countdown time using the Walk (Person) & Don't Walk (Flashing Hand) signal indications. The hand and person icons shall be displayed as normal during this cycle.

d) The countdown timer module shall continuously monitor the traffic controller for any changes to the pedestrian phase time and re-program itself automatically if needed.

e) The countdown module shall register the time for the walk and change intervals individually and shall begin counting down at the beginning of the pedestrian change interval. The countdown module shall display the numerals in a continuous display and shall not flash during the countdown.

f) When the flashing Hand becomes solid, the module shall display 0 for one second and then blank-out. The display shall remain dark until the beginning of the next countdown.

g) In the event of a pre-emption sequence during the pedestrian change interval, the countdown module shall skip the pre-empted change time and reach "0" at the same time as the flashing Hand becomes solid and then remain dark until the next cycle.

h) In the cycle following a pre-emption call, the signal shall display the correct time and not be affected by the reduced previous cycle. The countdown shall remain synchronized with the signal indications and always reach 0 at the same time as the flashing Hand becomes solid.

i) The countdown timer shall be capable of displaying two consecutive complete Pedestrian Phases outputted by the traffic controller (no steady Hand signal between cycles). NOTE: When a controller is programmed with the option to serve a second consecutive pedestrian phase (walk followed by flashing don't walk) if a pedestrian activates a pedestrian button during the change interval, and the controller is set to allow a second consecutive phase, the countdown will blank out during the walk, and restart counting down the correct time during the flashing don't walk, just as in a regular PED phase.

j) The countdown module shall not display an erroneous or conflicting time when subjected to defective load switches. Should there be a short power interruption during the PED change interval or if voltage is applied to both the hand and person simultaneously, the display will go to "0" then blank.

k) The countdown module shall have accessible dip-switches for the user selectable options. The unit shall have a removable plug on the rear allowing easy access to control the user selectable functions. The unit shall be shipped from the factory with all switches in the default "off" position. With the exception of the test mode, these dip switch selectable functions would typically be set at the initial installation of the Pedestrian signal.

(1) Dip Switch 1. Dark Cycle following a timing change

(a) Default Operation: In the default position this function is disabled. With this function disabled the countdown module will operate as follows:

i. If the clearance mode is shortened for a single cycle, for example for an emergency vehicle preemption, the countdown will return to normal operation on the following cycle using the learned timing.

ii. If the countdown module detects two consecutive shortened pedestrian clearance modes of identical length the countdown timer will display the new shorter time on the following cycle without the need for new blank learning cycle.

iii. If the countdown module detects a longer cycle, for example a programmed timing change, it will automatically display the lengthened time on the next cycle without the need for a new blank learning cycle.

(b) Optional Operation: With Dip switch 1 in the "on" position the countdown

module will operate as follow:

i. Any time the countdown module detects a timing change, either shorter or longer the countdown will run a new “learning” cycle. It will be blank for one cycle. After this blank cycle the unit will return to normal operation on the following cycle and display the new clearance timing learned.

(2) Dip Switch 2. Disable auto-sync mode.

(a) Default Operation: In the default “off” position the auto-sync is enabled. With this function enabled the countdown module will operate as follows:

i. Countdown start with the start of the “Flashing Hand” clearance mode.

ii. If in the “learning cycle” the countdown module detects a lag between the end of the walk mode and the start of the clearance mode the lag time will be measured and reduced from the first second in order to synchronize the end of the countdown “0” with the start of the solid hand signal.

(b) Optional Operation: With Dip switch 2 in the “on” position the auto-sync is disabled. With this function disable the countdown will operate as follows:

i. Countdown starts at the end of the walk signal and disregards any lag time in the start of the flashing hand signal.

ii. If clearance interval in not in full seconds then the final second of the countdown may be truncated as the hand signal becomes solid.

iii. If there is a brief power loss to the hand signal, < 1 sec, the unit may start counting for up to 2 seconds before it detects the power loss and goes blank.

(3) Dip Switch 3. Disables countdown operation.

(a) Default operation: In the default position the countdown timer is enabled. With this function enabled the countdown will operate as follows:

i. Countdown will function normally following either the default operation mode or if set, the selected dip switch options.

(b) Optional Operation: With Dip switch 3 in the “on” mode the countdown timer module is disabled. With this function disabled the countdown will operate as follows:

i. No countdown will be displayed but the hand / person portion of the pedestrian signal will operate as normal.

(4) Dip Switch 4. Memory Mode

(a) Default operation: In the default position the memory, in the event of a power loss, is disabled. With the memory disabled the countdown will operate as follows:

i. Countdown will maintain the learned clearance timing in memory.

ii. In the event of a power loss to the unit of 2 seconds or more in duration the memory will be lost and the timer will need to enter a new “learning” cycle upon the restoration of power.

(b) Optional operation: With Dip switch 4 in the “on” position the memory is enabled. With this function enabled the countdown will operate as follows:

i. Countdown will store the information from the “learning” cycle in memory for use in case of power loss.

ii. Upon returning from a power loss the countdown will use the timing stored in memory and not require the need for a new “learning’ cycle.

(5) Dip Switch 5. Diagnostic Test sequence

(a) Default Operation: With this function in the “off” position the countdown will operate as follows:

i. Countdown will function normally following either the default operation mode or if set, the selected dip switch options.

(b) Optional operation: With Dip switch 5 in the “on” position the diagnostic test mode is enabled. With this function enabled the countdown will function as follows:

- **i.** Countdown mode is disabled, to allow for diagnostic testing.
- **ii.** Upon application of power to either icon the countdown module will sequentially test the individual segments of the digits.
- **iii.** Upon also turning on Dip switch 4 the countdown will light up all segments to display the digit “88”.

e. Warranty Requirements.

1) Manufacturers shall provide a detailed written warranty issued by the factory located in the country of module origin with the following minimum provisions:

2) Modules shall, at the manufacturer’s option, be repaired or replaced if the module fails to function as intended due to workmanship or material defects within the first 60 months from the date of delivery.

3) Modules shall, at the manufacturer’s option, be repaired or replaced if the module exhibit luminous intensities less than the minimum specified values within the first 60 months of the date of delivery.

4) Upon request, the LED lamp module manufacturer shall provide written documentation of its ability to satisfy a worst-case, catastrophic warranty claim.

a) A current corporate annual report duly-certified by an independent auditing firm, containing financial statements illustrating sufficient cash-on-hand and net worth to satisfy a worst-case, catastrophic warranty claim is an example of suitable documentation.

b) The documentation shall clearly disclose:

- The country in which the factory of module origin is located.
- The name of the company or organization that owns the factory of module origin including any and all of its parent companies and/or organizations, and their respective country of corporate citizenship.

c) For firms with business and/or corporate citizenship in the United States of less than 7 years, the process by which the end-users/owners of the modules will be able to obtain worst-case, catastrophic warranty service in the event of bankruptcy or cessation-of-operations by the firm supplying the modules within North America, or in the event of bankruptcy or cessation-of-operations by the owner of the factory of origin, shall be clearly disclosed.

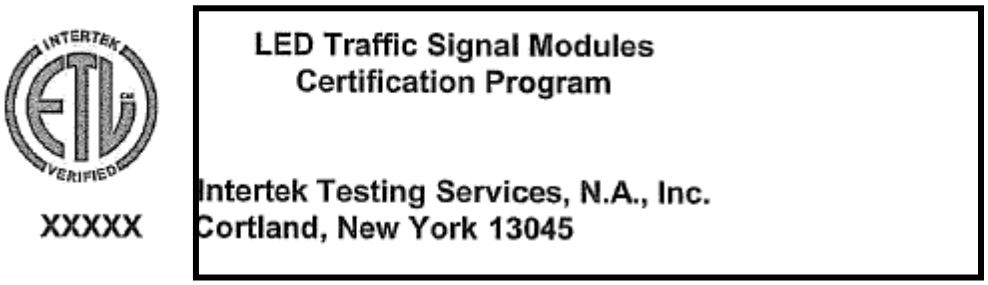

Figure 4.
Intertek- ETL Verified Label

F. Mast Arms and Poles.

1. General.

a. All steel traffic signal mast arm pole assemblies shall be designed and detailed by the manufacturer supplying the poles. In the event special sized poles and mast arms are required for a signalization project, the Contractor shall submit from the pole

manufacturer calculations of all loads transmitted to the bases prior to fabrication. Calculations shall be stamped by a registered professional engineer in the State of Iowa. All calculations shall be submitted with shop drawings and shall be reviewed by the Engineer prior to fabrication.

b. Use mast arm length and vertical pole height as specified in the contract documents.

c. Ensure the mast arms, poles, and supporting bases are galvanized on both interior and exterior surfaces according to ASTM A 123.

d. Use continuously tapered, round, steel poles of the transformer base type. Fabricate poles from low carbon (maximum carbon 0.30%) steel of U.S. standard gauge.

e. Ensure minimum yield strength of 48,000 psi after manufacture. Supply base and flange plates of structural steel complying with ASTM A 36 and cast steel complying with ASTM A 27, Grade 65-35 or better.

f. Where a combination street lighting/signal pole is specified in the contract documents, ensure the luminaire arm is mounted in the same vertical plane as the signal arm unless otherwise specified. Use a luminaire arm of the single member tapered type. Fabricate the pole with a minimum 4 inch by 6 inch handhole and cover located opposite the signal mast arm.

g. If allowed by the Engineer, poles and mast arms may be fabricated by shop welding two sections together, resulting in a smooth joint as follows:

- Ensure a minimum of 60% penetration for longitudinal butt welds in plates 3/8 inch and less in thickness, except within 1 foot of a transverse butt-welded joint. Ensure a minimum of 80% penetration for longitudinal butt welds in plates over 3/8 inch in thickness.
- Ensure 100% penetration for longitudinal butt welds in poles and arms within 1 foot of a transverse butt-welded joint.
- Ensure 100% penetration for transverse butt welds by using a back-up ring or bar to connect the sections.
- Examine the full length of all transverse butt welds and 100% penetration longitudinal butt welds by ultrasonic inspection according to the requirements of ANSI/AWS D1.1.
- Comply with ANSI/AWS D1.1 except as modified by Iowa DOT Article 2408.03, B.

h. Provide non-shrink grout (complying with Materials I.M. 491.13) or a rodent guard (complying with Materials I.M. 443.01) for placement between the pole base and the foundation.

2. Pole Design.

Comply with AASHTO 2013 Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals. Use a 90 mph basic wind speed with a 50 year mean recurrence interval for strength design. Use Category II for fatigue design. Apply only natural wind gust loads (i.e. do not apply galloping loads, vortex shedding loads, or truck-induced gust loads) for fatigue design. Install vibration mitigation devices on all traffic signal pole mast arms over 60 feet in length.

3. Hardware.

a. General.

1) Equip poles and mast arms with all necessary hardware and anchor bolts to provide for a complete installation without additional parts.

2) Furnish each anchor bolt with one leveling nut, one anchoring nut, and one jam nut (if required) on the exposed end and one of the following on the embedded end: nut, nut and plate, or nut and anchor bolt assembly ring plate. Use anchor bolts, nuts, and washers that comply with Materials I.M. 453.08.

b. Anchor Bolts.

- Use straight full-length galvanized bolts.
- Comply with ASTM F 1554, Grade 105, S4 (-20°F).
- Threads are to comply with ANSI/ASME B1.1 for UNC thread series, Class 2A

tolerance.
- The end of each anchor bolt intended to project from the concrete is to be color coded to identify the grade.
- Do not bend or weld anchor bolts.

c. Nuts.
- Comply with ASTM A 563, Grade DH or ASTM A 194, Grade 2H.
- Use heavy hex.
- Use ANSI/ASME B1.1 for UNC thread series, Class 2B tolerance.
- Nuts may be over-tapped according to the allowance requirements of ASTM A 563.
- Refer to Article 2522.03, H, 2, a through h, of the Standard Specifications for tightening procedure and requirements.

d. Washers.
Comply with ASTM F 436 Type 1.

e. Galvanizing.
Galvanize entire anchor bolt assembly consisting of anchor bolts, nuts, and washers (and plates or anchor bolt assembly ring plate, if used) according to the requirements of ASTM B 695, Class 55 Type 1 or ASTM F 2329 with zinc bath temperature limited to 850°F. Galvanize entire assembly by the same zinc-coating process, with no mixed processes in a lot of fastener assemblies.

G. Pole Bases.
All concrete pole bases shall be designed as per the standard plans. When special bases are required, all calculations of all loads transmitted to the bases shall be submitted prior to fabrication. A registered professional engineer in the State of Iowa shall stamp calculations. All calculations shall be submitted with drawings and shall be reviewed by the Engineer prior to fabrication.

H. Conduit And Conduit Fittings.

1. Conduit and conduit fittings for direct bury applications shall be galvanized rigid steel conforming to UL-6, UL Standard for Safety for Electrical Rigid Metal Conduit – Steel; high-density polyethylene conforming to ASTM F2160, Standard Specification for Solid Wall High Density Polyethylene (HDPE) Conduit Based on Controlled Outside Diameter (OD); or rigid polyvinyl chloride conforming to UL-651, UL Standard for Safety for Schedule 40 and 80 Rigid PVC Conduit.

2. Conduit and conduit fittings for boring applications shall be high density polyethylene conforming to ASTM D3035, Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter. Furnish in standard lengths with UL label.

3. Rigid steel conduit fittings shall be galvanized steel or galvanized malleable iron. Galvanizing shall comply with ASTM C123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products. PVC conduit fittings and cement shall be compatible with the PVC conduit. Transitions between HDPE and PVC conduits shall conform to the manufacturer's recommendations. Conduit size shall be the minimum trade size permitted for the application and shall have a constant circular cross sectional area. Conduit installed for above ground risers shall be galvanized rigid steel conduit.

I. Electrical Cable.

1. General.
- **a.** Electrical cable for intersection signalization shall be rated 600 volts minimum and be IMSA specification cable where applicable.
- **b.** The number of conductors and size of all electrical cable shall be as shown on the plans.

c. All wire shall be plainly marked on the outside of the sheath with the manufacturer's name and identification of the type of the cable.

d. All conductors used in the Controller cabinet shall be a minimum of No. 22 AWG (or larger, if required by the amperage requirements of the particular circuit), tinned copper conductors with a minimum of 19 strands, and shall conform to Federal Specifications IL-W-16878D, Type B or D, Vinyl-Nylon Jacket, 600 volts, 105°C., equal or better. Conductors used in the Controller cabinet shall conform to the NEC color codes:

- A. C. Neutral White
- A. C. Line Black
- Chassis, Safety Ground Green
- Control Any color not listed above

2. Power Lead-In Cable.

a. Power lead-in cable shall be of the sizes as shown on the plans.

b. Power lead-in cable shall be 600 volt, single conductor, stranded copper, Type USE, and UL approved.

3. Signal Cable.

a. Signal cable shall be 600 volt, multi-conductor, with copper conductor of the number and size as shown on the plans.

b. Signal cable shall meet the requirements of the International Municipal Signal Association (IMSA) specification 19-1, latest revision thereof for polyethylene insulated, polyvinyl chloride jacketed signal cable. All conductors shall be No. 14 AWG unless otherwise specified on the plans.

4. Loop Detector Wire (With Plastic Tubing).

The loop wire shall meet the requirements of the IMSA specification 51-5, latest revision thereof for a nylon or cross-linked polyethylene jacketed conductor, loosely encased in a polyethylene tube loop detector wire. The conductor shall be No. 16 AWG unless otherwise specified on the plans.

5. Detector Lead-in Cable.

Detector lead-in cable shall meet the requirements of IMSA specification 50-2, latest revision thereof for polyethylene insulated, polyethylene jacketed loop detector lead-in cable. All conductors shall be No. 14 AWG unless otherwise specified on the plans.

6. Ethernet Cable.

a. Ethernet cable for exterior signal devices shall have No. 24 AWG Bonded-Pairs, solid bare copper conductors, polyolefin insulation, polymer gel waterblocked, with a sun resistant LLPE jacket. Cable will have sequential marking at 2 foot intervals.

b. Cable shall be Belden 7934a or equivalent.

7. Tracer Cable and Locate Box.

a. A tracer cable shall be installed in all conduits with signal cables, detector lead-in cables, or fiber optic communication cables.

b. The tracer cable shall be a single conductor, stranded copper, No. 12 AWG, Type THHN, with UL approval and an orange colored jacket.

c. The tracer cable shall be identified in the controller cabinet, handholes, and poles by means of identification tags.

d. The Contractor shall provide a Locate Box outdoor-rated station protector on the outside of traffic controller cabinets. The Contractor shall run a ground wire to the main ground breaker of the traffic controller and run the fiber locate wires to the pedestals in the station protector. All tracer wires shall be interconnected to the ground post. The box shall be mounted to the exterior of the signal cabinet. A ground wire shall be attached to a lug within the box from the signal cabinet.

8. **Grounding Cables.**
   - **a.** The EGC shall be copper XHHW insulated wire sized per NEC section 250.122. Stainless steel fasteners and copper compression lugs shall be used. Use a specification grade bonding bushings, with stainless steel and hot dip galvanized construction. Use a listed copper conductive compound on all threads and conductors.
   - **b.** Grounding conductors within lighting standards and traffic signal poles shall be a No. 6 copper cable.
   - **c.** All grounding conductors that connect bonding bushings to grounding systems shall be a No. 6 copper cable.
   - **d.** All grounding conductors between terminal strip support plates and the cabinet grounding bus shall be a minimum of a No. 10 copper cable or a braided copper cable with equal cross sectional area.

J. Wire Splicing.

1. No below grade splicing of any traffic signal wiring, except loop to loop lead-in cable, shall be allowed. All splices shall be made in signal pole bases or approved above grade enclosures.

2. Wires being spliced shall be twisted in a clockwise direction in order that solderless connectors can be forced onto the splice.

3. Solderless connectors and splice cap covers shall be secured and made water tight with either vinyl electrical tape or a liquid insulating sealant equivalent to Scotchkote electrical coating.

4. All exposed single layer insulation, splice cap covers, and solderless connectors shall be encapsulated in rubber electrical tape. This is to provide a cushion to the single layer of insulation.

5. The rubber tape shall be encapsulated in a layer of vinyl electrical tape. All portions of the tape are to be smooth and well secured.

6. All splices shall be oriented with the splice above the spliced wire to avoid water collecting in the splice.

7. Two nylon tie straps shall then be secured approximately 2 inches beyond the wire splice at 1 inch increments to act as a strain relief to the splice.

K. Signing.

The Contractor shall furnish and install all regulatory and information signs as per project plans. The signs shall meet current MUTCD specifications in relation to size and message standards. The signs shall use urban rated prismatic reflective sheeting. The City of Council Bluffs Traffic Maintenance Division shall supply the mast arm street name signs, which shall be installed by the Contractor. Required brackets and/or supports for the mast arm signs shall be furnished by the Contractor. Mounting brackets shall be Pelco Galaxy T-Spar Sign Bracket or approved equivalent.

L. Led Roadway Luminaires.

1. Normative References.

The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by their basic designation only. Versions listed shall be superseded by updated versions as they become available.

- **a. ANSI.**
  - C78.377-2011 (or latest), American National Standard for the Chromaticity of Solid State Lighting Products

- C82.77-2002 (or latest), American National Standard for Harmonic Emission Limits - Related Power Quality Requirements for Lighting Equipment
- C136.2-2014 (or latest), American National Standard for Roadway and Area Lighting Equipment – Dialectric Withstand and Electrical Immunity Requirements
- C136.10-2010 (or latest), American National Standard for Roadway and Area Lighting Equipment – Locking-Type Photocontrol Devices and Mating Receptacles—Physical and Electrical Interchangeability and Testing
- C136.15-2011 (or latest), American National Standard for Roadway and Area Lighting Equipment – Luminaire Field Identification
- C136.22-2004 R2009 (or latest), American National Standard for Roadway and Area Lighting Equipment – Internal Labeling of Luminaires
- C136.31-2010 (or latest), American National Standard for Roadway Lighting Equipment – Luminaire Vibration
- C136.37-2011 (or latest), American National Standard for Roadway and Area Lighting Equipment - Solid State Light Sources Used in Roadway and Area Lighting
- C136.41-2013 (or latest), American National Standard for Roadway and Area Lighting Equipment—Dimming Control Between an External Locking Type Photocontrol and Ballast or Driver

b. ASTM.

- B117-11 (or latest), Standard Practice for Operating Salt Spray (Fog) Apparatus
- D523-08 (or latest), Standard Test Method for Specular Gloss
- D1654-08 (or latest), Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
- G154-06 (or latest), Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials

c. ENERGY STAR®.

- ENERGY STAR TM-21 Calculator, rev. 020712 (or latest, www.energystar.gov/TM-21Calculator)

d. Federal Communications Commission (FCC).

- 47 CFR Part 15, Telecommunication – Radio Frequency Devices

e. Federal Trade Commission (FTC).

- Complying with the Made in USA Standard, December 1998 (http://business.ftc.gov/advertising-and-marketing/made-usa)
- Green Guides, 16 CFR Part 260, Guides for the Use of Environmental Marketing Claims

f. IES.

- LM-50-13 (or latest), IES Approved Method for Photometric Measurement of Roadway and Street Lighting Installations
- LM-61-06 (or latest), IESNA Approved Guide for Identifying Operating Factors Influencing Measured Vs. Predicted Performance for Installed Outdoor High Intensity Discharge (HID) Luminaires
- LM-63-02 (R2008 or latest), ANSI/IESNA Standard File Format for the Electronic Transfer of Photometric Data and Related Information
- LM-79-08 (or latest), IESNA Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products
- LM-80-08 (or latest), IESNA Approved Method for Measuring Lumen Maintenance of LED Light Sources
- RP-8-00 (or latest), ANSI / IESNA American National Standard Practice for Roadway Lighting
- RP-16-10 (or latest), ANSI/IES Nomenclature and Definitions for Illuminating Engineering
- TM-3-95 (or latest), A Discussion of Appendix E - "Classification of Luminaire Lighting Distribution," from ANSI/IESNA RP-8-83
- TM-15-11 (or latest), Luminaire Classification System for Outdoor Luminaires

- TM-21-11 (or latest), Projecting Long Term Lumen Maintenance of LED Light Sources

g. International Electrotechnical Commission (IEC).
- 60929 Annex E, Control Interface for Controllable Ballasts (0-10V)
- 62386, Digital Addressable Lighting Interface (DALI)

h. LED Lighting Facts.
- Submission Requirements (http://www.lightingfacts.com/About/Content/Manufacturers/SubmissionRequirements)

i. Municipal Solid-State Street Lighting Consortium (MSSLC).
- Model Specification for Networked Outdoor Lighting Control Systems, V2.0 (or latest)

j. NEMA.
- LSD 63-2012, Measurement Methods and Performance Variation for Verification Testing of General Purpose Lamps and Systems

k. UL.
- 1598 Third Edition (or latest), Luminaires

2. Definitions.

a. Lighting terminology used herein is defined in IES RP-16. See referenced documents for additional definitions.

b. Exception: The term “driver” is used herein to broadly cover both drivers and power supplies, where applicable.

c. Clarification: The term “LED light source(s)” is used herein per IES LM-80 and TM-21 to broadly cover LED package(s), module(s), and array(s).

3. Product Requirements.

a. Tabulated summary of key parameters and product criteria

Table 1: Luminaire Designation: “250W HPS Equivalent LED”

PERFORMANCE CRITERIA					
INPUT POWER	Max. nominal luminaire input power				108 W
VOLTAGE	Nominal luminaire input voltage (or range as applicable)				120 V
LUMEN MAINT.	Min. % of initial output at 36,000 hours operation				90%
WARRANTY	Min. luminaire warranty				10 years
NOMINAL CCT	Rated correlated color temperature				4000 ± 350 K
BUG RATING	Max. nominal backlight-uplight-glare ratings				B2-U0-G2
DOWNWARD OUTPUT	Min. *maintained* luminaire output below horizontal				10,800 lm
FINISH	Luminaire housing finish color				Gray
WEIGHT	Max. luminaire weight				30 lb
LIGHT DISTRIBUTION	Distribution Type and Range				TYPE III Medium
MOUNTING	Mtg. method	☐ Post-top	☑ Side-arm	☐ Trun./yoke	☐ Swivel-tenon
	Tenon nominal pipe size (NPS)				2 inches
VIBRATION	ANSI C136.31	☑ Level 1 (normal)	☐ Level 2 (bridge/overpass)		
THERMAL ENVIRONMENT	Typical min. ambient temperature during operation				-20 °C
	Typical max. ambient temperature during operation				40 °C
ELECTRICAL IMMUNITY	ANSI C136.2 Comb. Wave Test Level	☑ Basic (6kV / 3kA)	☐ Enhanced (10kV / 5kA)	☐ Elevated (20kV / 10kA)	
CONTROL INTERFACE	☐ None	☐ ANSI C136.10 (3-pin)	☑ ANSI C136.41, 5-pin	☐ ANSI C136.41, 7-pin	
LED DRIVER	☐ Not dimmable	☑ Dimmable, 0-10V (IEC 60929)	☐ Dimmable, DALI (IEC 62386)		

b. General Requirements.

1) Transmissive optical components shall be applied in accordance with OEM design guidelines to ensure suitability for the environment (e.g., electromagnetic, thermal, mechanical, chemical).
2) Luminaire shall be designed for ease of component replacement and end-of-life disassembly.
3) LED light source(s) and driver(s) shall be RoHS compliant.
4) Nominal luminaire input wattage shall account for nominal applied voltage and any reduction in driver efficiency due to sub-optimal driver loading.
5) Luminaire shall accept the voltage or voltage range specified at 50/60 Hz, and shall operate normally for input voltage fluctuations of +/- 10%.
6) All internal components shall be assembled and pre-wired using modular electrical connections.
7) The following shall be in accordance with corresponding sections of ANSI C136.37:
   - Wiring and grounding
   - Terminal blocks for incoming AC lines (electrical mains wires)
   - Photocontrol receptacle
   - Latching and hinging
   - Mounting provisions
   - Ingress protection

c. Painted or Finished Luminaire Surfaces Exposed to the Environment.
1) Shall exceed a rating of six per ASTM D1654 after 1000 hours of testing per ASTM B117.
2) The coating shall exhibit no greater than 30% reduction of gloss per ASTM D523, after 500 hours of QUV testing at ASTM G154 Cycle 6.

d. Thermal Management.
1) Luminaire shall start and operate in ambient temperature range specified.
2) Maximum rated case temperature of driver and other internal components shall not be exceeded when luminaire is operated in ambient temperature range specified.
3) Mechanical design of protruding external surfaces (heat sink fins) shall facilitate hose-down cleaning and discourage debris accumulation.
4) Liquids or other moving parts shall be clearly indicated in submittals, shall be consistent with product testing, and shall be subject to review by Owner.

e. LED Driver, Photocontrol Receptacle, and Control Interface.
1) Luminaire designation(s) indicated “None” in Table 1 need not accept a control signal, and do not require a dimmable driver. If luminaire cannot be furnished without photocontrol receptacle, luminaire shall be furnished with ANSI C136.10 compliant photocontrol receptacle and shorting cap as directed by Owner.
2) Luminaire designation(s) indicated “ANSI C136.10, 3-pin” in Table 1 shall be fully prewired and shall incorporate an ANSI C136.10 compliant receptacle. If a dimmable LED driver is specified, its control wires shall be accessible and electrically isolated.
3) Luminaire designation(s) indicated “ANSI C136.41, 5-pin” in Table 1 shall be fully prewired and shall incorporate an ANSI C136.41 compliant receptacle. If a dimmable LED driver is specified, its 0-10V or DALI control wires shall be connected to the receptacle pads as specified in ANSI C136.41.
4) Luminaire designation(s) indicated “ANSI C136.41, 7-pin” in Table 1 shall be fully prewired and shall incorporate an ANSI C136.41 compliant receptacle. If a dimmable LED driver is specified, its 0-10V or DALI control wires shall be connected to the receptacle pads as specified in ANSI C136.41; connection of the two remaining pads shall be by Supplier, as directed by the Engineer.

f. Electrical Safety Testing.
1) Luminaire shall be listed for wet locations by a U.S. OSHA Nationally Recognized Testing Laboratory (NRTL).
2) Luminaire shall have locality-appropriate governing mark and certification.
3) Luminaire shall meet the performance requirements specified in ANSI C136.2 for dielectric withstand, using the DC test level and configuration.

g. Electrical Immunity.

1) Luminaire shall meet the performance requirements specified in ANSI C136.2 for electrical immunity, using the combination wave test level indicated in Table 1.
2) Manufacturer shall indicate on submittal form (Section 9) whether failure of the electrical immunity system can possibly result in disconnect of power to luminaire.

h. Interference and Power Quality.
1) Luminaire shall comply with FCC 47 CFR part 15 interference criteria for Class A (non-residential) digital devices.
2) Luminaire shall comply with section 5.2.5 (luminaires rated for outdoor use) of ANSI C82.77 at full input power and across specified voltage range.

i. Color Attributes.
1) Color Rendering Index (CRI) shall be no less than 60.
2) Nominal Correlated Color Temperature (CCT) shall be as specified in Table 1.
3) If submitted nominal CCT is listed in Table 2 below, measured CCT and Duv shall be as listed in Table 2.

Table 2: Allowable CCT and Duv (adapted from ANSI C78.377)

Manufacturer-Rated Nominal CCT (K)	Allowable IES LM-79 Chromaticity Values	
	Measured CCT (K)	Measured Duv
2700	2580 to 2870	-0.006 to 0.006
3000	2870 to 3220	-0.006 to 0.006
3500	3220 to 3710	-0.005 to 0.007
4000	3710 to 4260	-0.005 to 0.007
4500	4260 to 4746	-0.004 to 0.008
5000	4746 to 5311	-0.004 to 0.008
5700	5312 to 6020	-0.003 to 0.009
6500	6022 to 7040	-0.003 to 0.009

4) If submitted nominal CCT is not listed in Table 2, measured CCT and Duv shall be as per the criteria for Flexible CCT defined in ANSI C78.377.

j. Identification.
1) Luminaire shall have an external label per ANSI C136.15.
2) Luminaire shall have an internal label per ANSI C136.22.

k. Photocontrols.
1) Luminaire shall be furnished with a photocontrol as specified.
2) The locking-type photocontrol shall be an electronic control based on a solid-state photo sensor and relay switch circuit.
3) Switch operation shall have a rating of 1000 Watts tungsten and 1800 Watts ballast at 105-305 VAC.
4) For high in-rush LED type fixtures, the photocontrol switch operation shall have an 8 Amp Electronic Ballast rating at 105-305 VAC.
5) The photocontrol should fail in an ON state.
6) The photocontrol operating voltage shall be clearly identified on the control housing.
7) The photocontrol shall be equipped with a 2 to 5 second delay action eliminating activation by light flashes.
8) The photocontrol shall be equipped with standard three-prong twist and locking-type plug connection. The plug connection terminals shall be solid brass.
9) The photocontrol shall consist of industrial grade electronic components, 510 Joule MOV, solid state light sensor, and silver alloy relay contacts.
10) The photocontrol shall be 100% factory tested and function within specified light levels. The photo control shall be agency certified and tested accordingly.
11) The photocontrol shall meet agency standards for locking-type devices and all other requirements of ANSI C136.10-2010.
12) The photocontrol shall operate over a temperature range of -40°F to 158°F.
13) The photocontrol should have a manufacturer's limited warranty of 12 years

minimum.

4. **Required Submittals.**
   a. **Completed Product Submittal Form.**
   Family grouping in accordance with LED Lighting Facts is permitted, provided this is clearly indicated on the submittal form provided in Section 9, and clearly communicated via a letter that includes detailed calculations relating the tested product(s) to the submitted product.
   b. **Product Cutsheets.**
      - Luminaire cutsheets
      - Cutsheets for LED light source(s)
      - Cutsheets for LED driver(s)
      - If dimmable LED driver is specified, provide diagrams illustrating light output and input power as a function of control signal.
      - Cutsheets for surge protection device, if applicable

   c. Instructions for installation and maintenance.
   d. Summary of luminaire recycled content and recyclability. Shall be in accordance with the FTC Green Guides, expressed as a percentage of luminaire weight.
   e. **IES LM-79 Luminaire Photometric Report(s)**
      1) Shall be produced by the test laboratory
      2) The test laboratory shall satisfy LED Lighting Facts accreditation requirements.
      3) Shall include the following information
         - Name of test laboratory
         - Report number
         - Date
         - Complete luminaire catalog number
         - Description of luminaire, LED light source(s), and LED driver(s)
         - Goniophotometry
         - IES TM-15 Backlight-Uplight-Glare (BUG) ratings shall be for initial (worst-case) values, i.e., Light Loss Factor (LLF) = 1.0.
         - If luminaires are tilted upward for calculations in Article g, BUG ratings shall correspond to the same angle(s) of tilt.

   f. Lumen maintenance calculations and supporting test data.
      1) Shall be in accordance with LED Lighting Facts guidance.
      2) Exception: calculations shall be based on the cumulative hours of operation specified in Table 1.
      3) Submit completed ENERGY STAR TM-21 Calculator as an electronic Excel file.

   g. Computer-generated point-by-point photometric analysis of maintained light levels.
      1) Calculation/measurement points shall be per IES RP-8. Separated vehicular lanes, bikeways, and walkways shall be evaluated separately.
      2) Calculations shall be for maintained values, i.e. Light Loss Factor (LLF) < 1.0, where LLF = LLD x LDD x LATF, and
      3) Lamp Lumen Depreciation (LLD) shall be 0.90 or the value calculated in section 0, whichever is lower.
      4) Luminaire Dirt Depreciation (LDD) = 0.90
      5) Luminaire Ambient Temperature Factor (LATF) = 0.96
      6) Mesopic multipliers (i.e., effective luminance factors) shall not be used. All values shall assume photopic visual adaptation.
      7) Submit IES LM-63 format electronic file containing luminous intensity data associated with submitted LM-79 report(s) and used for point-by-point calculations.

   h. Summary of Joint Electron Devices Engineering Council (JEDEC) or Japan Electronics and Information Technology Industries (JEITA) reliability testing performed for LED packages
   i. Summary of reliability testing performed for LED driver(s)
   j. Written product warranty as per Article 6.

Applicable testing bodies are determined by the US OSHA as NRTL and include: Canadian Standards Association (CSA), Edison Testing Laboratory (ETL), and UL.

k. Documentation supporting any U.S. origin claims for the product, in accordance with FTC guidance.

5. Quality Assurance.

a. Before approval and purchase, Contracting Authority may request luminaire sample(s) identical to product configuration(s) submitted for inspection. Contracting Authority may request IES LM-79 testing of luminaire sample(s) to verify performance is within manufacturer-reported tolerances.

b. Electrically test fully assembled luminaires before shipment from factory.

c. After installation, Contracting Authority may perform IES LM-50 field measurements to verify performance requirements, giving consideration to manufacturing tolerances and measurement uncertainties as outlined in IES LM-61 and NEMA LSD 63.

6. Warranty.

a. Warranty shall be of the minimum duration specified in Table 1, and shall cover maintained integrity and functionality of the following:

- Luminaire housing, wiring, and connections
- LED light source(s)
- Negligible light output from more than 10% of the LED packages constitutes luminaire failure.
- LED driver(s)

b. Warranty period shall begin 90 days after date of invoice, or as negotiated by Contracting Authority such as in the case of an auditable asset management system.

7. Manufacturer Services.

Manufacturer or local sales representative shall provide installation and troubleshooting support via telephone and/or email.

8. Eligible Manufacturers.

Any manufacturer offering products that comply with the required product performance and operation criteria may be considered.

9. Product Submittal Form.

Luminaire designation	**250W HPS Equivalent LED**			
Luminaire manufacturer				
Luminaire model number				
Nominal IES TM-15 BUG ratings	B =	U =	G =	
Product family testing	☐ Submitted product is identical to tested product	☐ Submitted product differs from tested product(s) as explained in attached letter		
Housing finish color				
Tenon nominal pipe size	inches			
Nominal luminaire weight	lb			
Nominal luminaire EPA	ft^2			
Nominal luminaire input voltage	V			
Control interface	☐ None	☐ ANSI C136.10 (3-pin)	☐ ANSI C136.41, 5-pin	☐ ANSI C136.41, 7-pin
LED driver	☐ Not dimmable	☐ Dimmable, 0-10V (IEC 60929)	☐ Dimmable, DALI (IEC 62386)	
Electrical immunity—ANSI C136.2	☐ Basic	☐ Enhanced	☐ Elevated	

combination wave test level	(6kV / 3kA)	(10kV / 5kA)	(20kV / 10kA)
Upon failure of electrical immunity system	☐ Possible disconnect	☐ No possible disconnect	
ANSI C136.31 vibration test level	☐ Level 1 (Normal)	☐ Level 2 (bridge/overpass)	
Thermal management	☐ Liquids or moving parts	☐ No liquids or moving parts	
Luminaire warranty period	Years		
Rated life of LED driver(s)	Hours		
IES LM-80 test duration	Hours		
LED lumen maintenance *	☐ Reported (restricted)	☐ Calculated (unrestricted)	
Make/model of LED light source(s)			
	Nominal value	Tolerance (%)	
Luminaire input power—initial	W	W	
Luminaire input power—maintained **	W	W	
LED drive current—initial	mA	mA	
LED drive current—maintained **	mA	mA	
In-situ LED T_s	˚C	˚C	
LED lumen maintenance **	%	%	
CCT	K	K	
Additional product description			

* Manufacturer shall indicate which is applicable (check only one box) as per section 0 . According to IES TM-21, “Reported” values are restricted to 5.5x or 6x (depending on sample size) the duration of IES LM-80 testing, whereas “Calculated” (i.e., projected) values are unrestricted.

** As per section 4.6.

M. Signal Head Covers.

During construction all signal heads shall be covered with black vinyl covers specifically designed for this purpose. The covers shall be fastened to the heads with nylon straps utilizing a cam lock mechanism to secure the straps. Plastic bags, cardboard, burlap and other similar materials are not acceptable covers.

N. Signal Downtime.

1. The existing traffic signals shall remain in operation during this project until the new permanent signal is in operation and the new ramp intersection is open to traffic. Any signal downtime shall not occur during peak hours. The peak hours are Monday - Friday, 6:00 A.M to 9:00 A.M and 2:00 P.M to 6:00 P.M.

2. The Contractor at all times shall conduct the operation in such a manner as to insure the safety of the motorist, the pedestrian, and its own employees. The Contractor shall perform work in such a manner and sequence as to maintain vehicular and pedestrian traffic at all times and to maintain access to adjacent private properties, unless otherwise specified in the plans.

3. The Contractor shall furnish, install, and maintain all devices for directing, warning and rerouting traffic flow, including warning lights, barricades, and other devices necessary to

adequately inform the motorist of unusual or unsafe conditions and guide them safely through the Project work area.

4. All required barricades and signs shall be in accordance with Part VI of the MUTCD.

O. Temporary Traffic Signals.

1. The work shall consist of furnishing labor, materials and performing all work necessary to maintain, operate, modify, and remove the temporary traffic signals installed by the (511) traffic signal project at locations shown in the plans and as specified in these Special Provisions and contract documents. The temporary traffic signal shall consist of separate temporary signals utilized during the various stages of roadway construction. The Contractor will make all necessary revisions to the temporary traffic signals to make the temporary signal operational when the transition occurs from one stage of construction to another stage of construction. The temporary traffic signals shall remain in place and operational until the proposed permanent signals are installed and operational.

2. The Contractor shall be solely responsible for the maintenance, repair (if necessary) and removal of the temporary traffic signal installation during the time period the temporary traffic signal is activated and is operating. This shall include all costs to maintain, operate and repair (if necessary) the temporary traffic signal installation. The City shall be responsible for cabinet software, including traffic signal controller, signal timing, MMU and communications switch. The Contractor's responsibilities to operate, maintain and repair (if necessary) the temporary traffic signals, shall cease at such time the permanent traffic signals are transferred to the City of Council Bluffs. The traffic signal cabinet, handholes, and all associated equipment shall be reused as part of the permanent traffic signal and remain in place.

3. During the operation of the temporary traffic signal, if it's determined by the Engineer that subsequent signal timing modifications are necessary; the City will make all necessary programming changes. The Contractor shall contact the City at least 5 days prior to a transition from one stage of construction to another stage of construction to request a review and/or modification of the signal timings.

4. Vehicle Detection shall be maintained on all intersection approaches at all times. Radar presence detection shall be utilized and adjusted during the transition from one stage of construction to the next stage of construction to account for different traffic configurations. Radar detection utilized for the temporary signal shall be relocated to the permanent signal.

P. Schedule of Unit Prices

Prior to the preconstruction meeting the traffic signal contractor shall forward to the engineer a list of unit costs for the individual traffic signal items. The sum of costs for each item shall equal the total Contract Lump Sum price for the temporary traffic signal installation. The total cost shall not be unreasonably distributed among the individual unit items.

Q. Contractor Qualifications and Responsibilities.

1. The contractor must be licensed as an Electrical Contractor as required by Iowa law and shall have a licensed master electrician on staff.

2. The contractor is responsible for arranging and successful inspection by the City Electrical Inspector. The contractor shall be responsible for resolving all deficiencies identified by the City Electrical Inspector.

3. During construction of the project, it may be necessary for the DOT, the Contractor, or the

City to respond to a traffic signal operation malfunction. In the event of a traffic signal operations issue, the following will outline the roles and responsibilities for responding to and troubleshooting issues that arise:

a. The City will respond to and diagnose traffic signal operational issue.
- If issue related to internal signal controller, the City will correct the issues
- If issue related to hardware/construction, the City will contact the Contractor, or traffic signal subcontractor, to correct the issue.

b. The Contractor shall be responsible for intersection hardware, including the equipment within the cabinet.

c. The City will be responsible for cabinet software, including traffic signal controller, signal timings, MMU and communications switch.

d. The City will be responsible for existing fiber cable locates not installed by the project.

e. The Contractor shall be responsible for electrical locates and fiber communications locates installed as part of the project.

f. The Contractor shall be responsible for moving detectors and reprogramming detection zones based on the needs of the project.

230060.03 METHOD OF MEASUREMENT.

Measurement will be as follows:

A. Temporary Traffic Signals.
By count for each group installation of temporary traffic signals operated by a common control unit.

B. Traffic Signalization.
Lump sum item; no measurement will be made.

230060.04 BASIS OF PAYMENT.

Payment will be at the contract unit price as described below.

A. Temporary Traffic Signals.

1. Each, for individual group installations operated by a common control unit, normally four signal heads at the same traffic control area.

2. Payment is full compensation for furnishing, installing, maintaining and servicing the signal heads, signs, traffic detection system, and costs for electrical energy.

B. Traffic Signalization.
Payment will be at the lump sum price for Traffic Signalization. Partial payment will be made according to the approved schedule of unit prices.