



**SPECIAL PROVISIONS
FOR
TRAFFIC SIGNALIZATION**

**Muscatine County
STPN-038-1(15)--2J-70**

**Effective Date
June 16, 2020**

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

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

This part of the specifications includes the furnishing of all material and equipment necessary to complete, in place and operational, traffic control signal(s) as described in the project plans.

1.02 SUBMITTALS

Comply with Article 1105.03 of the Standard Specifications, as well as the additional requirements listed below. All of the following must be submitted within 30 days after awarding of the contract for the project. Verify the method of submittal with the Engineer.

- A. Schedule of Unit Prices:** Submit a completed schedule of unit prices. Estimates of the work performed on the project will be made by the Engineer and the unit costs will be used to prepare progress payments to the Contractor.
- B. Material and Equipment List:** Submit a completed list of materials and equipment to the Engineer for written approval before any equipment or materials are ordered.
- C. Contractor Certification:** Submit the name(s) and contact information of the International Municipal Signal Association (IMSA) Level II Certified Traffic Signal Technician(s) working on the project and a copy of their IMSA certificate.
- D. Shop Drawings:** Submit shop drawings for traffic signal poles and structures to be furnished on the project. Submit catalog cuts and manufacturer's specifications for all items in the equipment list.

1.03 DELIVERY, STORAGE, AND HANDLING

Comply with Section 1106 of the Standard Specifications.

1.04 SCHEDULING AND CONFLICTS

Comply with Article 1108.02, I of the Standard Specifications.

1.05 SPECIAL REQUIREMENTS

Comply with the current edition of the MUTCD as adopted by the Iowa DOT.

1.06 MEASUREMENT AND PAYMENT

A. Traffic Signalization:

1. Measurement: Lump sum item; no measurement will be made.
2. Payment: Payment will be at the lump sum price for traffic signalization.

PART 2 - PRODUCTS

2.01 UNDERGROUND

A. Handhole:

1. General:

- a. Cable Hooks: Provide four galvanized steel cable hooks with a minimum diameter of 3/8 inch and a minimum length of 5 inches. Provide with Type I handholes only.
- b. Granular Base: Comply with the following gradations; however, the Engineer may authorize a change in gradation, subject to materials available locally at the time of construction.

Sieve	Percent Passing
2"	100
1 1/2"	80 to 90
1"	12 to 20
3/4"	0 to 0.5

- c. Cover: Include "TRAFFIC SIGNAL" as a message on the cover. Alternate messages may be required as specified in the contract documents.

2. Precast Composite Handhole:

Composite handhole shall be of pre-cast polymer concrete, polyester resin materials. The junction box shall be of dimensions shown in the plans, style stackable type assembly. The handhole shall have cover rated for heavy-duty loading. The legend "Electric" shall be on both pieces of the lid and be secured by two stainless steel bolts. A minimum of four cable hooks shall be installed in each junction box to support the traffic signal cables.

Precast handholes shall be:

Medium size model CHA173018HE001 from MacLean Highline.

- Installed on corners near poles

Small size model CHA132415HE001 from MacLean Highline.

- Installed near traffic signal poles when greater than 5 feet from nearest pullbox

3. Composite Handhole and Cover: Composed of mortar consisting of sand, gravel, and polyester resin reinforced by a woven glass fiber mat or of resin mortar and fiberglass. Provide a skid resistant surface on the cover. Provide two 3/8-16 UNC stainless steel hex head bolts with washers. The handholes shall have ANSI Tier 22 ratings and the covers shall have ANSI Tier 15 ratings. Covers shall be two-piece for Type III and Type IV

handholes.

B. Conduit:

1. General:

- a. Furnish weatherproof fittings of identical or compatible material to the conduit. Use standard factory elbows, couplings, and other fittings.
- b. Use a manufactured conduit sealing compound that is readily workable material at temperatures as low as 30°F and will not melt or run at temperatures as high as 300°F.

2. Steel Conduit and Fittings:

- a. Comply with ANSI C80.1.
- b. Use weatherproof expansion fittings with galvanized, malleable iron, fixed and expansion heads jointed by rigid steel conduit sleeves. As an option, the fixed head may be integral with the sleeve, forming a one piece body of galvanized malleable iron.
- c. Provide steel bushings.

3. Plastic Conduit and Fittings:

- a. PVC:
 - 1) PVC Schedule 40 plastic conduit and fittings complying with NEMA TC-2 (pipe), NEMA TC-3 (fittings), and UL 651 for Schedule 40 heavy wall type.
 - 2) Solvent welded, socket type fittings, except where otherwise specified in the contract documents.
 - 3) Threaded adaptors for jointing plastic conduit to rigid metal ducts.
 - 4) Provide bell end fittings or bushings.
- b. HDPE:
 - 1) Comply with ASTM F 2160 (conduit) and ASTM D 3350 (HDPE material), SDR 11.
 - 2) Use black with red stripe colored conduit.
 - 3) Continuous reel or straight pieces to minimize splicing.
 - 4) For dissimilar conduit connections, provide an adhesive compatible with both materials.
 - 5) Conduit couplers for HDPE to HDPE connections shall be double e-loc couplers.
 - 6) HDPE duct plugs shall be blank expandable duct plugs with elastomeric gaskets and rope loops.

C. Wiring and Cable: Provide wire that is plainly marked on the outside of the sheath with the manufacturer's name and identification of the type of the cable.

1. Signal Cable: Comply with IMSA Specifications 19-1 (PVC jacket) or 20-1 (polyethylene jacket) stranded for polyethylene insulated, 600 volt, stranded-multi-conductor copper wire, Method 1 color code.

- a. A 20 conductor No. 14 AWG stranded copper between pole base terminal block and traffic signal 332 cabinet terminal block.
- b. A seven conductor No. 14 AWG stranded copper between pole base terminal block and traffic signal or pedestrian signal heads.
- c. A seven conductor No. 14 AWG stranded copper between pole base terminal block and traffic signal 332 cabinet terminal block.
- d. A two conductor No. 14 AWG shielded, stranded copper for pedestrian pushbutton signal

2. WaveTronix Matrix Cable: Comply with manufacturer's recommendations.

3. Pull Tape: Flat polyester pull-tape with a minimum pulling strength of 1250 pounds and

permanent sequential footage markings.

D. Footings:

1. Use Class C structural concrete complying with Section 2403 of the Standard Specifications.
2. Use uncoated reinforcing steel complying with Section 4151 of the Standard Specifications.

E. Bonding and Grounding:

1. **Ground Rods:** Provide 5/8 inch by 8 foot copper clad, steel ground rod at each pole and controller footing.
2. **Bonding Jumper or Connecting Wire:** Provide No. 6 AWG bare conductor, copper wire.

2.02 DETECTION

A. Pedestrian Push Button Detectors:

1. Assembly:

- a. Ensure the entire assembly is weather tight, secure against electrical shock, withstands continuous hard usage.
- b. Provide a removable contact assembly mounted in a die cast aluminum case.
- c. Ensure contacts are normally open with no current flowing except at the moment of actuation.
- d. Ensure the contacts are entirely insulated from the housing and operating button with terminals for making connections.
- e. Provide housing with one outlet for 1/2 inch pipe.

2. Solid State Pedestrian Push Buttons (non-APS):

- a. Housing: Die cast aluminum, weather tight, secure against electrical shock and withstands continuous hard usage.
- b. Push Button: Nonrusting metal alloy, ADA compliant, 2 inch diameter with 3 pounds maximum operational force.
- c. Switch: Solid state rated at 20 million operations minimum.
- d. Operating Temperature: -30°F to + 165°F.
- e. Pelco SE 2019-08-29 push buttons. Body color shall be yellow.

3. **Signs:** Furnish R10-3e signs complying with MUTCD and with directional arrows as shown on the plans.

B. Radar Detection System

1. Equipment: Wavetronix radar detection system.

2.03 CABINET AND CONTROLLER

A. Caltran Controller, Cabinet, and Auxiliary Equipment: Comply with the latest edition of Caltran standards.

1. Controller:

- a. Solid state modular design with digital timing and capable of accommodating at least eight phases.
- b. Fully prompted, front panel keyboard with menu driven programmability.
- c. Local time base scheduler including automatic accommodation for daylight savings

- time.
- d. Local coordination control.
- e. Local preemption control with at least four programmable internal preemption sequences.
- f. Current software and documentation.
- g. Data retained in a memory medium that does not require battery backup.
- h. Econolite Cobalt controller.

2. Cabinet:

- a. Unpainted aluminum cabinet according to Caltran standards.
- b. Aluminum cabinet riser with same dimensions as cabinet and 12 inch to 18 inch height, as specified in the contract documents.
- c. Police door with auto/flash switch, manual/stop time switch, and on/off power switch for signal heads only. Controller to remain in full operation regardless of switch positions.
- d. Maintenance panel on inside of the main door containing the following test switches.
 - 1) Controller power switch.
 - 2) Detector test switches.
 - 3) Stop time switch.
 - 4) Signal flash switch.
- e. Heavy-duty clear plastic envelope attached to inside wall of cabinet or cabinet door, for cabinet wiring diagrams, 12 inches by 18 inches minimum.
- f. GFI electrical outlet and lamp in accessible location near the front of the cabinet. GFI outlet fused separately from main AC circuit breaker. Fluorescent or LED cabinet lamp connected and fused with GFI outlet.
- g. Back panel positions to accommodate phasing and expansibility specified in the contract documents.
- h. Power protection devices including AC power circuit breakers, radio interference suppressors, and lightning and surge protectors.
 - 1) AC field service single pole, nonadjustable, magnetic breaker rated for 117 VAC operation, NEC approved.
 - 2) Radio interference suppressors (RIS) as required to minimize interference in all broadcast transmission and aircraft frequency bands.
 - 3) Lightning arrestor/surge protector capable of withstanding repeated (minimum of 25) 30,000 ampere surges.
- i. Neatly train wiring throughout the cabinet and riser. Bundle and attach wiring to interior panels using nonconductive clamps or tie-wraps.
- j. The cabinet shall contain strong mounting shelves to accommodate the mounting of the controller and all auxiliary equipment. The mounting shelves shall permit the controller and all auxiliary equipment to be withdrawn from the cabinet for inspection or maintenance without breaking any electrical connections or interrupting operation of the controller.
- k. The cabinet shall contain two thermostatically controlled duct fan units with a minimum rating of 100 CFM in free air shall be installed in the cabinet to provide forced air ventilation through the cabinet. The fan unit shall be mounted to the inside top of the cabinet and shall be easily removed and replaced without having to dismantle any part of the cabinet or exhaust duct system. The thermostat controlling the fans shall be 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. The fans shall intake air through filtered vents located near the bottom of the cabinet or cabinet door and exhaust it through a weather-proof, screened duct located near the top of the cabinet. Fiberglass type dry filters shall be used to cover the air intakes into the cabinet. These filters shall be easily removed and replaced and be of standard dimensions commercially available. The filters shall be provided with positive retainment on all sides to prevent warpage and entry of foreign matter around the edges.

- 3. Auxiliary Equipment:** Conflict monitor/malfunction management unit, flasher, load switches, terminals and facilities, and miscellaneous equipment and materials according to Caltran standards.

2.04 POLES, HEADS, AND SIGNS

- A. Vehicle Traffic Signal Head Assembly:** Comply with current MUTCD and ITE standards.

1. Housing:

- a. Individual signal sections made of durable polycarbonate. Color shall be black and integral to the materials composition.
- b. Self-contained unit capable of separate mounting or inclusion in a signal face containing two or more signal sections rigidly and securely fastened together.
- c. Equipped with openings and positive locking devices in the top and bottom so that it may be rotated between waterproof supporting brackets capable of being directed and secured at any angle in the horizontal plane.
- d. Doors and lenses with suitable watertight gaskets and doors that are suitably hinged and held securely to the body of the housing by simple locking devices of non-corrosive material. Doors are to be easily removed and reinstalled without use of special tools.

- 2. Optical System:** Designed to prevent any objectionable reflection of sun rays even at times of the day when the sun may shine directly into the lens.

- 3. Lenses:** 12 inch diameter polycarbonate. Do not use glass lenses.

4. Visors:

- a. Standard Installation:
 - 1) Each signal lens is to have a visor with the bottom 25% open.
 - 2) Minimum 0.1 inch in thickness and black in color.
 - 3) Fits tightly against the housing door with no filtration of light between the visor and door.
 - 4) Minimum length of 9 1/2 inches. Ensure the visor angle is slightly downward.
- b. Optically Programmed Sections: Make sure the optical unit and visor are designed as a whole to eliminate the return of outside rays entering the unit from above the horizontal.

5. Terminal Block:

- a. Three-section signal equipped with a six position terminal block.
- b. Four- and five-section signal equipped with an eight position terminal block.

6. Backplate:

- a. Manufactured one-piece, durable, black plastic capable of withstanding a 100 mph wind.
- b. Provides 5 inches of black field around the assembly.

7. Mounting Hardware:

- a. Fixed: 1 1/2 inch aluminum pipe and fittings, natural aluminum finish for galvanized poles or match the pole color. Mounting shall be via drill and tap instead of banding.
 - Pelco SE-3291 Black Nylon
- b. Universally Adjustable: Rigid mounted, consisting of both top and bottom brackets and easily adjustable in both horizontal and vertical planes.
 - Pelco SP-1079-FL Astro-Brac Clamp Kit, Stellar Stainless Cable Mount
- c. All traffic signal heads shall be side mounted when installed on a vertical pole. Post top mounting is not allowed. Factor side mounting and minimum mounting height requirements when determining pedestal pole shaft lengths.

- 8. LED Modules:** Comply with current ITE standards. LED modules shall be provided with a 15 year performance warranty.

9. Pedestrian Signal Heads:

- a. Pedestrian signal head mounting assemblies shall be Pelco SE-3291.

- B. Pedestrian Traffic Signal Head Assembly:** Comply with current MUTCD and ITE standards. City of Muscatine standard signal head is Eagle (Mobotrex) SG7SH10A3BBB10-02.

1. Housing:

- a. Made of a durable polycarbonate. Color shall be black and integral to the materials composition.
- b. Self-contained unit capable of separate mounting or inclusion in a signal face containing two signal sections rigidly and securely fastened together.
- c. Equipped with openings and positive locking devices in the top and bottom so that it may be rotated between waterproof supporting brackets capable of being directed and secured at any angle in the horizontal plane.
- d. Doors and lenses with suitable watertight gaskets and doors that are suitably hinged and held securely to the body of the housing by simple locking devices of noncorrosive material. Doors are to be easily removed and reinstalled without use of special tools.

2. Visor:

- a. Tunnel type visor attached to the housing door by stainless steel screws.
- b. Fit tightly against the housing door to prevent any filtration of light between the door and the visor.
- c. Ensure the visor angle is slightly downward.

3. LED Module:

- a. Provide a LED unit(s) for the filled upraised hand symbol, walking person symbol, and countdown timer.
- b. Ensure immediate blank out of the countdown timer display upon recognizing a shortened "Walk" or a shortened "Flashing Don't Walk" interval.
- c. LED modules shall be provided with a 15 year performance warranty.

C. Traffic Signal Poles and Mast Arms:

1. General:

- a. Pole height as specified in the contract documents.
- b. Ensure the poles, and supporting bases are galvanized inside and out according to ASTM A 123.
- c. Use continuously tapered, round, steel poles of the anchor base type. Fabricate poles of low carbon (maximum carbon 0.30%) steel of U.S. standard gauge.
- d. Provide a 6 inch by 24 inch handhole in the pole shaft for cable access and terminal block mounting. Cable access through pole should be a minimum of 5 inch by 7 inch opening. Provide a cover for the handhole. Secure the cover to the base with simple tools. Hardware to be corrosion resistant.
- 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 round tapered 2.0 IP pipe (2.38 O.D.) type. Fabricate the pole with a minimum 4 inch by 6 inch handhole and cover located opposite the signal mast arm. Cable opening into mast

- arm from pole shall be a minimum of 2.5 inches.
- g. Luminaire mounting height shall be 30 feet unless otherwise specified. Install cable support for luminaire power supply in pole top.
 - h. If allowed by the Engineer, poles and mast arms may be fabricated by welding two sections together, resulting in a smooth joint and factory welded as follows:
 - 1) 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.
 - 2) Ensure 100% penetration for longitudinal butt welds in poles and arms within 1 foot of a transverse butt-welded joint.
 - 3) Ensure 100% penetration for transverse butt welds by using a back-up ring or bar to connect the sections.
 - 4) 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.
 - 5) Comply with ANSI/AWS D1.1 except as modified by Article 2408.03, B of the Standard Specifications.
 - i. 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 as shown on the figures.
- 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:**
 - 1) Use straight full-length galvanized bolts.
 - 2) Comply with ASTM F 1554, Grade 105, S4 (-20°F).
 - 3) Threads are to comply with ANSI/ASME B1.1 for UNC thread series, Class 2A tolerance.
 - 4) The end of each anchor bolt intended to project from the concrete is to be color coded to identify the grade.
 - 5) Do not bend or weld anchor bolts.
 - c. **Nuts:**
 - 1) Comply with ASTM A 563, Grade DH or ASTM A 194, Grade 2H.
 - 2) Use heavy hex.
 - 3) Use ANSI/ASME B1.1 for UNC thread series, Class 2B tolerance.
 - 4) Nuts may be over-tapped according to the allowance requirements of ASTM A 563.
 - 5) Refer to Article 3.04, B, 2 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.

D. Traffic Signal Pedestal Poles:

1. Materials:

- a. **Pedestal:** The height from the bottom of the base to the top of the shaft as specified in the contract documents.
 - b. **Pedestal Shaft:** Schedule 80 with satin brush or spun finish aluminum tubing. Top of the shaft outer diameter to be 4 1/2 inches and provided with a pole cap. Supply base collar for poles with shaft lengths greater than 10 feet.
 - c. **Pedestal Base:** Cast aluminum, square in shape, with a handhole.
 - 1) **Handhole:** Minimum of 6 inches by 6 inches and equipped with a cast aluminum cover that can be securely fastened to the base with the use of simple tools.
 - 2) **Base:** Minimum weight of 20 pounds with a four bolt pattern uniformly spaced on a 12 1/2 inch diameter bolt circle. Meet or exceed AASHTO breakaway requirements.
2. **Anchor Bolts:** Muscatine Power and Water (MPW) will supply anchor bolts and bolt circle template per manufacturer's recommendations.

E. Pedestrian Push Button Post:

1. **Material:** Use Frey Manufacturing Corporation Crosswalk Pedestals that comply with Figure 8010.106, as revised (figure located in plans). Materials shall be galvanized or aluminum finish.

F. Traffic Signs:

1. Comply with Section 4186 of the Standard Specifications.
2. Use a universally adjustable mast arm mounted sign bracket.
3. Comply with MUTCD and the contract documents for the street name sign dimensions, letter height and font, and sheeting.

PART 3 - EXECUTION

3.01 UNDERGROUND

A. Handhole:

1. Locations:

- a. Do not construct in ditch bottoms, low areas where ponding of water may occur, or where they will be subject to normal vehicular traffic.
- b. With Engineer approval, additional handholes may be placed, at no additional cost to the Contracting Authority, to facilitate the work.

2. **Excavation:** Excavate as necessary to accommodate the handhole and granular base. The Contractor is responsible for incidental sidewalk removal and replacement necessary to complete the signal construction. Whenever excavation is made across parkways, gravel driveways, sodded areas or other surfaces, the sod, topsoil, crushed stone and gravel shall be replaced or restored as nearly as possible to its original condition and the whole area involved shall be left in a neat and presentable condition. Concrete sidewalk pavements, base courses, bituminous surfaces and other disturbed surfaces shall be

replaced with new materials and the cost shall be incidental to the work. All waste material and debris shall be disposed of at a sanitary landfill, or other site approved by the Engineer, at the Contractor's expense.

3. Granular Base: Install 8 inch thick granular base extending a minimum of 6 inches beyond the outside walls of the handhole.

4. Placement:

- a. In paved areas, install the handhole at an elevation so the casting is level and flush with the pavement. In unpaved areas, install the handhole approximately 1 inch above the final grade.
- b. Verify ring placement. Invert rings when installed in paved areas.

5. Conduit:

- a. Remove knockouts as necessary to facilitate conduit entrance. Conduits may enter from bottom through sweep.
- b. Extend conduit into the handhole, through a knockout, approximately 2 inches beyond the inside wall or above bottom. Conduit to slope down and away from the handhole.
- c. Place non-shrink grout (complying with Materials I.M. 491.13) in the opening of the knockout area after placement of conduit.
- d. Cap unused conduits with duct plugs.

6. Cable Hooks: Install cable hooks centered between the knockouts and the top of the handhole for Type I handholes only.

7. Backfill: Place suitable backfill material according to Section 2552 of the Standard Specifications.

8. Casting: Place the casting on the handhole. Ensure the final elevation meets the handhole placement requirements.

B. Conduit:

1. General:

- a. Place conduit to a minimum depth of 30 inches and a maximum depth of 48 inches below the gutterline. When conduit is placed behind the curb, place to a minimum depth of 30 inches and a maximum depth of 48 inches below top of curb.
- b. Change direction at handholes or by bending, such that the conduit will not be damaged or its internal diameter changed. Ensure bends are uniform in curvature and the inside radius of curvature of any bend is no less than six times the internal diameter of the conduit.
- c. On the exposed ends of conduit, place bell-end fittings on PVC or HDPE conduit and bushings on steel conduit prior to installing cable. Extend all conduits a minimum of 2 inches and a maximum of 4 inches above the finished surface of any footing or structural base.
- d. When it is necessary to cut and thread steel conduit, do not allow exposed threads. Ensure conduits and fittings are free from burrs and rough places. Clean, swab, and ream conduit runs before cables are installed. Use nipples to eliminate cutting and threading where short lengths of conduit are required. Coat damaged galvanized finish on conduit with zinc rich paint. Use only galvanized steel fittings with steel conduit.
- e. Install duct plugs in conduit ends. When duct plugs are not practical, pack conduit ends with conduit sealing compound.
- f. Install pull tape in each conduit segment and secure to duct plugs at each end.

2. Trenched Installation:

- a. Place backfill in layers not to exceed 12 inches in depth with each layer thoroughly compacted before the next layer is placed. Ensure backfill material is free of cinders, broken concrete, or other hard or abrasive materials.
- b. Remove all surplus material from the public right-of-way as soon as possible.
- c. The Contractor is responsible for incidental sidewalk removal and replacement necessary to complete the signal construction. Whenever excavation is made across parkways, gravel driveways, sodded areas or other surfaces, the sod, topsoil, crushed stone and gravel shall be replaced or restored as nearly as possible to its original condition and the whole area involved shall be left in a neat and presentable condition. Concrete sidewalk pavements, base courses, bituminous surfaces and other surfaces shall be replaced with new materials and the cost shall be incidental to the work.

3. Trenchless Installation:

- a. When placing conduit under pavements, use the trenchless installation methods described in Section 2553 of the Standard Specifications.
- b. If trenchless methods that compact soils in the bore path are used, provide sufficient cover to prevent heaving of overlying paved surfaces.
- c. Do not allow pits for boring to be closer than 2 feet to the back of curb, unless otherwise specified in the contract documents.

C. Wiring and Cable:

1. Where practical, follow color codes and ensure cables are properly labeled at the controller with durable labels, or other appropriate methods, attached to the cables. Label home runs for signal and video cables as follows: northeast corner is blue, southeast corner is orange, southwest corner is yellow, and northwest corner is green. Other Iowa City cable and color codes are as follows:

Left turn signals = 1 tape
 Through signals = 2 tapes
 Right turn signals = 3 tapes

2. Install continuous runs of vehicle and pedestrian signal cables from the vehicle or pedestrian signal head to the handhole compartment of the signal pole base. Install continuous runs of vehicle and pedestrian signal cables from the handhole compartment of the signal pole base to the terminal compartment in the controller cabinet. Do not splice signal cables in underground handholes. Wavetronix connection box may not fit in pole bases and may be spliced in handhole with waterproof gel splice covers. The street light wires will be spliced in the handhole and fused.
3. Provide a minimum of 4 feet of additional cable at each handhole and loosely coil the extra cable on the handhole cable hooks. Provide a minimum of 2 feet of additional cable at each signal pole (measured from the handhole compartment in the pole to the end of the cable). Provide a minimum of 10 feet of additional cable at each controller base.
4. Pull cables through conduit using a cable grip designed to provide a firm hold upon the exterior covering of the cable or cables, and minimize dragging on the ground or pavement.

D. Footings and Foundations:

1. **Excavation:** Excavate to the size, shape, and depth specified in the contract documents. Ensure the bottom of all foundations rest securely on firm undisturbed

soil. Minimize over-excavation to ensure support and stability of the foundation. The Contractor is responsible for incidental sidewalk removal and replacement necessary to complete the signal construction. Whenever excavation is made across parkways, gravel driveways, sodded areas or other surfaces, the sod, topsoil, crushed stone and gravel shall be replaced or restored as nearly as possible to its original condition and the whole area involved shall be left in a neat and presentable condition. Concrete sidewalk pavements, base courses, bituminous surfaces and other surfaces shall be replaced with new materials and the cost shall be incidental to the work.

2. **Footing:** Provide a means for holding all of the following elements rigidly in place while the concrete is being placed.
 - a. **Forms:**
 - 1) Set the forms level or sloped to meet the adjacent paved areas.
 - 2) When adjacent to paved areas, shape the top 11 inches of the footing to be square and flush with the surrounding paved area. Provide preformed expansion material between the footing and paved areas.
 - 3) When installed in an unpaved area, set the top of the footing 2 inches above the surface of the ground.
 - b. **Reinforcing Steel:** Install reinforcing steel.
 - c. **Conduit:** Install conduit.
 - d. **Anchor Bolts:**
 - 1) Set anchor bolts using a template constructed to accommodate the specified elevation, orientation, and spacing according to the pole and controller manufacturer's requirements.
 - 2) Center the pole anchor bolts within the concrete footing.
 - 3) Protect the anchor bolts until poles are erected.
 - 4) Orient controller footing with the back of the cabinet toward the intersection such that the signal heads can be viewed while facing the controller, unless otherwise directed by the Engineer.
 - e. **Concrete:**
 - 1) Place concrete to form a monolithic foundation. Consolidate concrete by vibration methods.
 - 2) Finish the top of the base level and round the top edges with an edging tool having a radius of 1/2 inch. Provide a rubbed surface finish on the exposed surface of the footing.
 - 3) Allow the footings to cure a minimum of 4 days prior to erecting the poles and 7 days prior to installing the mast arms. Times may be shortened if supported by strength test results.
3. **Backfill:** Place suitable backfill material according to Section 2552 of the Standard Specifications.
4. **Removal:** Where shown on the plans, the Contractor shall remove the top of the existing mast arm footings, anchor bolts, and conduits to 36 inches below the existing top of curb or edge of pavement elevation. Waste materials shall be removed from the site and disposed in accordance with local regulations. Backfilling for the removal shall be performed according to Section 2552 of the Standard Specifications. The upper 6 inches of the removal area, if outside the proposed pavement, shall be backfilled with topsoil.

E. Bonding and Grounding:

1. Ensure the traffic signal installation is grounded as required by the National Electric Safety Code.
2. Install a ground rod at each signal pole and controller footing.

3. Use PVC conduit within the footing to accommodate the connection between the top of the footing and the ground rod.
4. Bond poles to ground rods with copper wire. Connect ground wires to ground rods with approved mechanical connectors.
5. Bond rigid steel conduit ends in handholes with copper wire and approved fittings.

3.02 DETECTION

A. Pedestrian Push Button Detectors:

1. Install according to the manufacturer's recommendations.
2. Seal the wire entrance into the pedestrian push button assembly.

C. Radar Detection System: Install according to the manufacturer's recommendations and as specified in the contract documents.

3.03 CABINET AND CONTROLLER

A. Controller, Cabinet, and Auxiliary Equipment:

1. Install according to the manufacturer's recommendations and as specified in the contract documents.
2. Install on pre-placed caulking material on the concrete base. After the cabinet is installed in place, place caulking material around the base of the cabinet.

B. Controller: Install according to the manufacturer's recommendations and as specified in the contract documents.

C. Traffic Signal Controller Base: Traffic signal controller bases shall be Quazite PB40441218B24 precast bases.

3.04 POLES, HEADS, AND SIGNS

A. Vehicle and Pedestrian Traffic Signal Heads:

1. Inspect each signal head assembly while still on the ground for the following:
 - a. Physical defects
 - b. Visor type
 - c. LED wattage
 - d. Lens orientation
 - e. Wiring connections
2. Attach signal head mounting hardware according to the manufacturer's recommendations. Apply anti-seize compound to all mechanical fasteners.
3. Adjust each signal head both vertically and horizontally to approximate a uniform grade of all like signal heads.
4. During the course of construction and until the signals are placed in operation, cover signal faces or turn away from approaching traffic. When ready for operation, plumb and aim the heads.

5. Pole mounted signal heads and pedestrian push buttons are shown on the plans and schematic drawings in schematic form only. Pole mounted signal heads are generally intended to be mounted on the face of pole with respect to oncoming traffic. Modifications to this are required when the view of the pole mounted signal indication is blocked. Pedestrian push buttons shall be located on the pole face so the arrow on the R10-3e sign directs pedestrians to the appropriate crosswalk. The location of signal heads in which the view of the indications is blocked or partially blocked by utility poles, trees, other signal heads or any physical obstructions shall be adjusted to a location approved by the Engineer. Standard heights and locations shown on the plans are typical for unobstructed locations. Signal heads installed without approval of the Engineer, which in the opinion of the Engineer are obstructed, shall be relocated at the Contractor's expense. Holes in the poles due to this signal relocation shall be plugged in a manner acceptable to the Engineer.

B. Traffic Signal and Pedestal Poles and Pedestrian Push Button Posts:

1. Erect all poles and posts vertically under normal load.
2. Securely bolt the bases to the cast-in-place concrete foundations using the following procedures. Perform this work only on days with winds less than 15 mph. Tighten all of the nuts in the presence of the inspector. Once the tightening procedure is started, complete on all of the base plate nuts without pause or delay.
 - a. Use properly sized wrenches or sockets, or both, designed for tightening nuts or bolts, or both, to avoid rounding or other damage to the nuts. Do not use adjustable end or pipe wrenches.
 - b. Ensure base plates, anchor rods, and nuts are free of all dirt or debris.
 - c. Apply stick wax or bees wax to the threads and bearing surfaces of the anchor bolt, nuts, and washers.
 - d. Tighten top nuts so they fully contact the base plate. Tighten leveling nuts to snug tight condition. Snug tight is defined as the full effort of one person on a wrench with a length equal to 14 times the bolt diameter but not less than 18 inches. Apply full effort as close to the end of the wrench as possible. Perform tightening by leaning back and using entire body weight to pull firmly on the end of the wrench until the nut stops rotating. Perform a minimum of two separate passes of tightening. Sequence tightening in each pass so that the nut on the opposite side, to the extent possible, is subsequently tightened until all of the nuts in that pass have been tightened.
 - e. Tighten top nuts to snug tight as described for the leveling nuts.
 - f. Match-mark the top nuts and base plate using paint, crayon, or other approved means to provide a reference for determining the relative rotation of the nut and base plate during tightening. Further tighten the top nuts tightened in two passes, as listed in the following table, using a striking or hydraulic wrench. Follow a sequence of tightening in each pass so that the nut on the opposite side, to the extent possible, is subsequently tightened until all nuts in that pass have been turned. Do not allow the leveling nut to rotate during the top nut tightening.

Bolt Tightening

Anchor Bolt Size	First Pass	Second Pass	Total Rotation
Less than or equal to 1 1/2 inch diameter	1/6 turn	1/6 turn	1/3 turn
Greater than 1 1/2 inch diameter	1/12 turn	1/12 turn	1/6 turn

- g. Lubricate the jam nuts, place, and tighten to snug tight.
3. A torque wrench should be used to verify that a torque at least equal to the computed verification torque, T_v , according to paragraph 6.9 of FHWA Guidelines for the

Installation, Inspection, Maintenance, and Repair of Structural Supports for Highway Signs, Luminaires, and Traffic Signals, is required to additionally tighten the top nuts. An inability to achieve this torque should be interpreted to indicate that the threads have stripped and should be reported to the Engineer.

4. After leveling the poles, use non-shrink grout or a rodent guard between the pole base and the foundation. When non-shrink grout is used, neatly finish exposed edges of grout to present a pleasing appearance, and place a weep hole in the grout.
 5. Apply anti-seize compound to all mechanical fasteners on pole access doors.
 6. Install pedestrian push button post caps with tamper-proof set screws per manufacturer's direction or by driving the cap a minimum of 1/2 inch onto the post.
- C. Traffic Signs:** Install signs using universally adjustable sign brackets via drill and tap. Apply anti-seize compound to all mechanical fasteners.

3.05 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. Complete restoration according to the applicable sections of the Standard Specifications and as specified by the contract documents.

3.06 TESTING

- A. Notify the Engineer 48 hours in advance of the time and date the signal or signal system will be ready for turn on. Do not turn on the signal or signal system without authorization of the Engineer.
- B. Ensure a representative from the manufacturer and/or supplier of signal controller or other authorized person is at the project site when the signal controllers are ready to be turned on to provide technical assistance including, as a minimum, programming of all necessary input data.
- C. All required signal timing data will be provided by the Engineer.
- D. A test period of 30 calendar days will start upon confirmation from the Engineer that the signal or signal system is operating consistent with the project requirements. Any failure or malfunction of the equipment furnished by the Contractor, occurring during the test period will be corrected by the Contractor at no additional cost to the Contracting Authority. Upon confirmation by the Engineer that any failure or malfunction has been corrected, a new test period of 30 calendar days will start, exclusive of minor malfunctions such as lamp burnouts. Repeat this procedure until the signal equipment has operated satisfactorily for 30 consecutive calendar days.
- E. After signal turn on and prior to completion of the 30 calendar day test period, respond, within 24 hours, to perform maintenance or repair of any failure or malfunction reported.

3.07 DOCUMENTATION

- A. Provide file documentation packages with each signal system, consisting of the following:
 1. Complete cabinet wiring diagram.

2. Complete physical description of the equipment.
 3. Controller printout or equal documentation of initial controller settings installed in the field or in the office.
 4. Product manuals for all cabinet equipment.
 5. Standard industry warranties on equipment supplied.
 6. Documentation of field cable labeling scheme.
 7. Diagram of phasing and detector locations.
 8. One set of as-built construction plans indicating changes from the original contract documents.
- B. Supply two complete sets of documentation. One set to be placed in the controller cabinet and the other set (less construction plan) to be delivered to the Engineer.