SP-157028
(New)

SPECIAL PROVISIONS
FOR
TRAFFIC SIGNALIZATION

Linn County
STP-U-1187(790)--70-57

Effective Date
December 19, 2017

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

TRAFFIC SIGNALIZATION – INDEX

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PART 1 GENERAL

1.01 – Section Includes

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- Conduit
- Concrete Bases and Hand holes
- Poles and Mast Arms
- Signals
- Controllers and Cabinets

1.02 – Acronyms and Definitions

A. City – City of Cedar Rapids
B. NTCIP – National Transportation Communications for ITS Protocol

1.03 – Description of Work

A. All work shall be in accordance with the contract documents and result in a fully-functional traffic signal system.
B. Electrical: includes furnishing and installing all electrical components.
C. Conduit: includes furnishing and installing conduit fittings associated with traffic signals.
D. Concrete Bases and Hand holes: includes furnishing and installing bases and hand holes associated with traffic signals.
E. Poles and Mast Arms: includes furnishing and installing the poles associated with traffic signals.
F. Signals: includes furnishing and installing the signals.
G. Controllers and Cabinets: includes furnishing and installing controllers, cabinets, network hardware and accessories.

1.04 – Submittals

A. Submit test results as set forth in the contract documents.
B. Submit certificate of compliance indicating the materials incorporated into the work comply with the contract documents.
C. Supplier shall submit two copies of Shop Drawings of Signal Poles and Mast Arms to the Engineer for review prior to manufacture of the mast arm assemblies. Manufacture shall not begin until the Shop Drawings have been approved by the Engineer. The intent of the Engineer's review and approval is to assist the supplier in interpreting the Specifications. Shop Drawing approval shall not relieve the supplier of the responsibility for errors in the Shop Drawing or the requirements of the specifications.
D. Submit the name(s) and contact information of the IMSA Level II Certified Traffic Signal Technician(s) working on the project and a copy of their IMSA certificate.
E. Submit within 30 days after awarding of the contract for the project a completed schedule of unit prices. Estimates of the work performed on the project will be made by the City and the unit costs will be used to prepare progress payments to the Contractor.

1.05 – Delivery, Storage and Handling

A. Deliver only materials that fully conform to these Specifications.
    1. Complete the equipment list by writing in the name of the equipment manufacturer and catalog number of each item listed which he proposed to install. Before beginning work on the project, submit two copies of the equipment list, and two copies of catalog cuts for all materials supplied.
    2. Prior to ordering any materials, provide certification from the manufacturers of all electrical equipment, conduit, and cable stating said material complies with the Specifications.
B. Store material in accordance with the manufacturer's recommendations and in locations which will minimize the interference with operations, minimize environmental damage, and protect adjacent areas.

C. Remove and dispose of unacceptable materials in accordance with the contract documents.

1.06 – Scheduling and Conflicts

A. Schedule Work to minimize disruption of public streets and facilities.
B. Discontinue Work which will be affected by any conflicts discovered or any changes needed to accommodate unknown or changed conditions and notify the Engineer.

1.07 – Special Requirements

A. All work and materials incorporated into this Project shall conform to all applicable local, state, and Federal requirements.
B. Furnish upon request from the Engineer, a sample of any item or material proposed for use on for this Project.
C. Any modifications of the installation are subject to the approval of the Engineer.
D. Unless otherwise specified in the contract documents, the installation of all signal equipment shall be in accordance with the current version of the Traffic Signal Maintenance Handbook of the IMSA.
E. The painted surface of any equipment damaged in shipping or installation shall be retouched or repainted in a manner satisfactory to the Engineer.
F. A certified IMSA Traffic Signal Level II Field Technician must be present on the jobsite at all times.
G. The fiber optic cable Splicing, Termination and Testing contractor must have a minimum of 5 years' experience in splicing, terminating and testing fiber optic cable and associated equipment.
H. The Splicing, Termination and Testing Contractor shall have at least one BICSI certified or equivalent technician on staff, in a supervisory position, and be available for reference and supervision of splicing, termination, and testing of all equipment specified.
I. Provide all labor required for splicing, termination, and testing of City of Cedar Rapids supplied materials. Provide a list of all materials used to contractors along with data sheets for installation standards and practices.

PART 2 PRODUCTS

2.01 – Electrical

A. Service Conductor (Power Cable) shall be 600 volts, stranded conductor. It shall comply with the Standard Specifications and shall be U.L. listed for type "USE." The sheath shall be white for the neutral cables.
B. Signal cable shall be stranded and conform to the requirements of IMSA 19-1 or 20-1, or latest revision thereof. The number and size of conductors shall be as specified on the plans.
C. Loop detector lead-in cable shall conform to the requirements of IMSA 50-2, latest revision thereof.
D. Detector loop wire shall conform to the requirements of IMSA 51-5, latest revision thereof. The encasing tube shall be polyvinyl chloride.
E. Above grade wire connectors shall be prefilled with dielectric grease to resist moisture. Below grade connectors shall be direct burial rated. Connectors shall be rated for proper voltage, wire size, temperature, and quantity.
F. Connectors shall be approved by the Engineer prior to incorporation in the Work.
G. Tracer wire shall be a No. 10 AWG wire single conductor, stranded copper, Type THHN, with UL approval and orange jacket. Tracer wire shall be grounded at each pole base.
H. Ground rods shall be high strength steel rods with chemically bonded copper coverings to provide high conductivity and to prevent electrolytic action. Rods shall be full length as shown on the plans with nominal diameter of 5/8 inch unless otherwise specified. Ground rods shall conform to the requirements of IMSA specification No. 62-1956, latest revision.
I. All ground wires shall be No. 6 AWG copper wire unless otherwise specified on the plans.

J. All electrical equipment shall conform to the standards of the NEMA. All Work shall conform to the standards of the NEMA. All Work shall conform to the requirements of the National Electrical Code. All miscellaneous electrical equipment shall be approved.
K. Circuit breakers shall conform to manufacturer's requirements. Breakers shall be housed in approved enclosure.

2.02 – Conduit

A. Galvanized rigid steel conduit (RSC) shall meet the requirements of ANSI Standard Specification C 80.1, latest revision. The number and size of conduits shall be as called for on the plans. Conduit shall be of standard length with each length bearing the UL approved label.
B. PVC conduit shall be Schedule 80. Conduit shall be of standard length with each length bearing the UL approved label. Schedule 40 elbows will only be allowed in concreted foundations.
C. Conduit fittings shall conform to the requirements of ANSI Standard Specification C 80.4, latest revision. All fittings used with rigid steel conduit shall be threaded galvanized steel. Fittings of aluminum or zinc alloys are not acceptable.
D. HPDE conduit, where specified in the Plan Documents, shall meet or exceed the requirements of ASTM F 2160 "Standard Specification for Solid Wall High Density Polyethylene (HPDE) Conduit Based on Controlled Outside Diameter (OD)". Joints and couplings shall meet or exceed ASTM F 2176 "Standard Specification for Mechanical Couplings Used on Polyethylene Conduit, Duct and Inner duct". Orange conduit will be required for underground fiber optic cable and red or black conduit for traffic signal cable installation. Manufacturer's certifications may be required for HDPE conduit.

2.03 – Foundations

A. Concrete for foundations shall be Class "C" structural concrete, C-4 mix.
B. The shape of the top of the foundation shall be cylindrical.
C. All forms used for the construction of the foundations shall be removed after the appropriate amount of cure time.
D. Reinforcement for foundations shall meet the requirements of Section 2404 of the Standard Specifications.

2.04 – Hand holes

A. Hand holes shall be Quazite Open Bottom Box (Nestible) style enclosures. They shall be Hubbell Power Systems product number PR2732BA36 or approved equal.
B. Hand hole covers shall be Hubbell Power Systems product number PR2700HA0046 or approved equal. A logo with "Traffic Signal" shall be on the cover.
C. Hand holes shall be placed on course aggregate base, Iowa DOT Gradation No. 5.

2.05 – Pole and Mast Arm Assembly

A. General
    1. The mast arms, signal support poles, luminaire support poles, and luminaire arms shall be continuous tapered, round or multi-sided steel poles of the anchor base type. The poles and mast arms shall be a minimum of 7 gauge fabricated from one length of steel sheet up to 50' member lengths with one continuous arc welded vertical longitudinal seam, unless otherwise approved by the Engineer. The poles and mast arms shall be fabricated from corrosion resistant steel meeting requirements of ASTM A595 GRADE A, ASTM A572 GRADE 55 or 65. The base and flange plates shall be fabricated from A36 structural steel. After manufacture, poles and mast arms shall have minimum yield strength of 55 KSI. The base plate shall be attached to the lower end of the shaft by a continuous fillet arc weld on both the inside and outside of the shaft.

2. Longitudinal seam welds shall meet as a minimum; an electric resistance weld for ASTM A595, a hybrid laser continuous arc weld for A572 GRADE 55, and a continuous arc weld for ASTM A572 GRADE 65 pole and mast arm members.
3. Welding, fabrication, and inspection shall conform to Section 2525 of the Standard Specifications. Pole manufacturers shall certify that only certified welding operators in accordance with the Standard Specifications are used. The welding consumables used shall be in accordance with the approved list furnished by the Iowa DOT.
4. Personnel performing nondestructive testing shall be qualified in accordance with the American Society for Nondestructive Testing Recommended Practice No. SNT-TC-1A and applicable Supplements B (Magnetic Particle) and C (Ultrasonic). Evidence shall be presented for approval of the Engineer, concerning their qualifications. A report shall be required showing that welds have been inspected and found satisfactory. The cost of all nondestructive testing shall be paid by the supplier and will be considered incidental.

B. Mast Arms
1. The mast arms and poles shall be designed in accordance with the 2013 AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaries 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 (wind dampening devices) on all traffic signal mast arms over 60 feet in length. The length of the mast arms shall be as specified in the Plans.
2. When loaded with the signals and signs the mast arms shall have a slight rise. Unloaded the maximum angle between the mast arm and horizontal shall be 2 degrees to 5 degrees depending on the length of the mast arm, unless approved by the Engineer.

C. Poles
1. The pole shall be designed to support the mast arm so when it is equipped with the traffic signals and/or signs it will provide a minimum of 16 feet and a maximum of 19 feet clearance from the street surface to the bottom of the signal heads and a minimum of 17 feet clearance to signs.
2. The pole shall be equipped with two reinforced hand holes with covers. One hand hole shall be located 18 inches above the base and 180 degrees with respect to the mast arm. The second-hand hole shall be located directly opposite the traffic signal mast arm. Securing the cover to the pole shall be done with the use of simple tools.
3. Provide a lug in the pole base near the hand hole to permit connection of a No. 6 AWG grounding wire.
4. Provide a J-hook wire support (a curved 3/8-inch diameter steel bar) 6 inch to 12 inches above and 90 degrees with respect to the opening for each mast arm and luminaire arm.

D. Signal Pole and Mast Arm Loading: Traffic signal poles and mast arms shall be fabricated to handle the loading indicated in the Plans.

E. Finish
1. Unless otherwise specified on the plans, poles and mast arms shall be galvanized steel per the following:
2. The assemblies shall be hot-dipped galvanized to the requirements of ASTM A123 for fabricated products or ASTM A153 for hardware items.
3. Packaging: All parts shall be packaged, wrapped, or cradled in a manner which will insure arrival at the destination without damage to the surface.

F. Hardware
1. The mast arms and poles shall be equipped with all necessary hardware, shims and anchor bolts to provide for a complete installation without additional parts.
2. The anchor bolts shall meet the requirements of ASTM F1554 Grade 105 S5 Class 2A or approved equal.
3. Bolts attaching the arms to the pole shall meet the requirements of ASTM A325 or approved equal.
4. The anchor bolts shall be hot dip galvanized and have a 4 inch long 90 degree bend at the other end. The Fabricator shall submit drawings for the anchor bolts and base plate design. All hardware shall be steel, hot dipped galvanized meeting the requirements of ASTM F

2329, with a zinc bath temperature limited to 850°F or mechanically galvanized according to ASTM B 695, Class 55, Type 1.

5. Anchor bolt covers, pole top covers, and mast arm end covers shall be gray cast iron castings conforming to ASTM Designation: A48 Class 30 or fabricated from ASTM A36 Steel.

G. Luminaire Extension
   1. Traffic signal pole assemblies which require luminaire extensions are indicated on the Plan Documents. The pole for the luminaire extension shall be a separate pole connected to the signal pole via a bolted internal tapped plate connection above the mast arm. Provide 1-inch-thick steel plates welded to the bottom of the luminaire pole and the top of the signal pole. Provide a reinforced hand hole and cover (4 inch by 6 1/2 inch minimum) near the bottom of the luminaire pole.
   2. The pole for the luminaire extension shall be vertical and shall provide a 35 foot luminaire mounting height, unless approved by the Engineer. Luminaire arm shall be a single arm, unless otherwise noted on the contract documents.
   3. The length of the luminaire arm shall be 15 feet, and the orientation of the luminaire arm shall be 10 degrees counterclockwise from the mast arm, unless otherwise noted on the plans.
   4. A 1 1/8 inch minimum diameter hole shall be drilled in the pole directly opposite the luminaire arm attachment point and in line with the hole leading into the luminaire arm.
   5. The luminaire arm shall be capable of supporting a pan-tilt-zoom camera or a video detection camera, and a radar detector or wireless detection access point.

H. Future Luminaire Arm
   1. The traffic signal assemblies without luminaire extensions shall be designed to support a future luminaire extension.
   2. The pole shall have a 1 inch thick steel plate welded in the top of the pole to receive the future luminaire extension. The steel plate shall be tapped unless otherwise specified on the plans.
   3. The future luminaire will be installed 35 feet above the pavement surface and the luminaire arm will extend 15 feet from the pole, unless otherwise specified on the plans.

2.06 – Signals

A. General
   1. The signal heads shall be complete with all fittings and brackets for a complete installation. Each signal shall consist of a main body assembly, optical units, necessary screws, wing nuts, eyebolts, etc., and shall be delivered completely assembled. All hardware including hinge pins, wing nuts, eye bolts or latch bolts shall be made of a solid non-corrosive metallic material to prevent seizure or corrosion by the elements. Each signal shall be smooth both inside and outside and shall contain no sharp fins or projections of any kind. The doors and visors shall be flat black. All metal parts shall be painted with one coat of primer and two coats of a high-grade Federal Black enamel. All parts of the vehicle signals shall be in compliance with the latest ITE Report on Adjustable Face Vehicle Traffic Control Signal Heads.
   2. The electrical and optical system of the signal head shall be designed to operate on 110 to 120 volt, single phase, 60 Hertz alternating current.
   3. All exterior surfaces shall be black.
   4. Main Body Assembly of the signal unit shall consist of one or more polycarbonate sections having integral cast serrations so when assembled with the proper brackets they may be adjusted in increments and locked securely to prevent moving. The sections shall be designed so that when assembled they interlock with one another. All joints between sections shall be waterproof. The sections shall be held firmly together by locknuts or other means approved by the Engineer. Any open end on assembled signal face housing shall be plugged with an ornament cap and gasket.
   5. All traffic signal vehicle head housings and assemblies shall be EAGLE polycarbonate or approved equal.
   6. Doors and Optical Units

a. The doors shall be made of polycarbonate. Each door shall be of the hinged type and shall beheld closed by a wing nut or other approved means. The hinge pins shall be designed so that the doors may be easily removed and reinstalled without the use of special tools. Each door shall have a polycarbonate visor designed to shield each lens. The inside of each visor shall be flat black.
b. The wire entrance fitting shall be made of malleable iron or other approved material equipped with a standard 1 1/2 inch pipe fitting for attachment to the signal head. It shall be provided with weatherproofing means so that when it is attached to the top of the signal a weatherproof assembly results. Positive locking means shall be provided so that the signal cannot loosen from the fitting. The fitting shall be provided with an insulation bushing at the point where wires enter. The fitting shall be provided with self-locking features to prevent the signal head from turning out of directional adjustment in a strong wind. It shall be painted in color to match that of the signal.

B. Vehicle Signals
1. In addition to meeting the requirements of Section A., Vehicle Signals shall meet the following requirements:
a. All signal indications shall be Light Emitting Diode (LED) Signal Modules.
b. Visors shall be of the tunnel type not less than eight inches in length and shall be designed in a manner such that the visor may be easily installed or removed from the signal head.
c. A terminal block shall be mounted in the back of the second section of the signal head. The terminal blocks shall be secured at both ends.
d. Signals shall be shipped completely assembled with tunnel visors attached to the signal door.

C. Pedestrian Signals: In addition to meeting the requirements of Section A, Pedestrian Signals shall meet the following requirements:
1. Pedestrian signals shall consist of a single unit, nominal 16 inch by 18 inch, with “egg crate” housing and mounting attachments. The left half shall display a “HAND” symbol and a “WALKING PERSON” symbol. The right half shall display clearance interval countdown numerals.
2. The signals shall operate with LED lamps, incandescent look that meet or exceed ITE PTCSI-2 LED Pedestrian Signal Specifications.
3. The lenses shall be made of vandal resistant polycarbonate or acrylic plastic. Unless otherwise specified on the Plan Documents, the symbols on these lenses shall be at least 9 inches high and shall be designed to produce a maximum legibility both day and night. The “HAND” symbol shall be Lunar White and the “WALKING PERSON” symbol and numerals shall be Portland Orange. The background or field around both messages shall be black.

D. Mounting Assemblies
1. Side of pole mount brackets shall be black nylon 1 way upper and lower arm assemblies.
2. Mounting assemblies shall be watertight and all open segments of the fittings shall be plugged with an ornamental plug and a gasket.
3. Mast arm mounting brackets shall be SKYBRACKET cable-mount or approved equal and shall be furnished with all incidentals necessary for complete installation.
4. Banding will not be allowed. All signal heads and signal components shall be drilled and tapped.
5. Brackets shall not be mounted on top of traffic signal pedestal poles.

E. Each signal shall be packed or crated separate and complete by itself. The outside of each package or crate shall clearly show the manufacturer, type, catalog number, Purchaser purchase order number and project. Mounting attachments may be shipped separate from the signals, but the boxes or crates shall be marked clearly with the same information as the signals. Mounting attachments of different types shall not be mixed in one box or crate.

2.07 – Traffic Signal Indications

A. LED Vehicle Signal Modules shall comply with the latest revision of the “Equipment and Material Standards of the Institute of Transportation Engineers: Chapter 2a: VTCSH Part 2: Light Emitting

Diode (LED) Vehicle Signal Modules" Note the following: Section 5.5 Dimming (Optional) is not required. Section 5.8 Failed State Impedance (Optional) is required. Compliance with all other sections of this standard is required.

B. The LED signal modules shall come with a 15 year warranty.

2.08 – Back plates

A. Back plates shall be 0.125 inch thick thermoplastic and provide a minimum of a 5 inch black field around the assembly. Corners of the back plates shall be rounded with a 2 1/2 inch radius.
B. Back plates shall be supplied with attaching bolts or screws in sufficient quantity to securely hold the back plates to the signal heads.
C. Back plates will be installed with all vehicle signal heads, unless otherwise directed by the Engineer.
D. Back plates shall be Pelco vacuumed formed and compatible with EAGLE polycarbonate housings or approved equal.

2.09 – Aluminum Traffic Signal Pedestal

A. The pedestal shaft shall be fabricated of aluminum tubing with a wall thickness of not less than 0.125 inches. Shaft shall have a brushed aluminum finish. The top of the shaft shall have an outer diameter of 4 1/2 inches.
B. The shaft shall be attached to a square cast-aluminum base with a hand hole. The size of the hand hole shall be at least 8 1/2 inches by 8 1/2 inches and equipped with a cover, which can be securely fastened to the base with the use of simple tools. A lug shall be provided near the hand hole to permit connection of a No. 6 AWG grounding wire.
C. Signal head mounting assemblies shall be approved by the Engineer prior to installation.
D. Pedestals shall be equipped with all necessary hardware, shims and anchor bolts to provide for a complete installation without additional parts.
E. The pedestal base shall be designed to mount on four 3/4 inch anchor bolts spaced evenly around a 12 3/4 inch diameter bolt circle.

2.10 – Accessible Pedestrian Pushbutton Detectors

A. The Accessible Pedestrian Signal (APS) shall be an audible-tactile pedestrian signal system and shall consist of all electronic control equipment, mounting hardware, push buttons and signs designed to provide both a pushbutton with a raised, vibrating tactile arrow on the button as well as a variety of audible indications for differing pedestrian signal functions.
B. The APS shall meet the following requirements:
    1. 2009 MUTCD, Chapter 4E – Pedestrian Control Features.
    2. NEMA TS 2 Section 2.1 requirements for Temperature and Humidity, Transient Voltage Protection and Mechanical Shock and Vibration.
    3. IEC 61000-4-4; 4-5 Transient Suppression requirements.
    4. FCC Title 47, Part 15, Class A, Electronic Noise requirements.
C. The APS pushbutton enclosure shall meet the NEMA 250 – Type 4X enclosure requirement.
D. The APS pushbuttons, control unit, and intersection configurator shall be POLARA EZ Communicator Navigator (EN23TB1-B), CCU2EN, and ECONFIG or approved equals.
E. Upon installation, the APS shall have the following functional requirements:
    1. APS Functional Requirements. The APS shall have the following functional features:
        a. The APS shall be programmable and adjustable. Programming and adjustments shall be made using a laptop computer or vendor supplied programmer. No additional hardware or equipment shall be required. The APS shall be fully compatible with the three latest versions of the Windows operating platform. The programmable features shall be:
            1) Push-button locator tone
            2) Walk and Wait audible message
            3) Audible push-button informational message
            4) Audible crossing beacon

5) Vibrating tactile arrow
6) Independent minimum and maximum volume limits for the Locator Tone, Walk and Audible Beaconing features

b. All audible features shall emanate from the pedestrian pushbutton housing. The APS shall utilize digital audio technology, having a minimum 12 bit sample at a 16k Hz sample rate. Total harmonic distortion shall be less than 3% at 75 decibels. The APS shall provide independent ambient sound adjustment for the Locator Tone feature. The APS shall allow for Locator Tone volume to be set below the ambient noise level. The system shall have, at a minimum, three programmable locator tones. All sound levels shall adjust automatically utilizing an internally mounted, interval ambient sensing microphone, in accordance with the MUTCD.
c. The APS shall monitor the Walk condition for conflict operation. As a standalone unit, the APS shall disable the Walk functionality should a conflict be detected.
d. The APS system shall log cumulative call data. The data shall be date and time stamped, and shall be accessible via laptop.
e. The system shall have a programmable Extended Push Activation feature with the ability to extend the Walk time and provide an informational audible message. Activation shall be programmable from one to six seconds.
f. The system shall provide a programmable audible Wait message when the button is pushed. The message shall only annunciate once per actuation.

F. The APS manufacturer must provide the required voice messages in each button as defined below. Additionally, the APS manufacturer must supply backup copies of the voice messages to the City of Cedar Rapids.

The contractor shall present the order form below to the Accessible Pedestrian Signal (APS) manufacturer so the appropriate Braille message is added to the pedestrian information sign and the correct voice messages are programmed in the pedestrian push buttons.

Accessible Pedestrian Signal (APS)
ORDER FORM
(Fill out one form per intersection)

Intersection: Edgewood Road NW & Ellis Road NW

Project No.: **Total Quantity of Pedestrian Push Buttons** 2

Control Board: One needed for each intersection **Qty** 1

CCU: (Central Control Unit) One needed for each intersection **Qty** 1

CONFIG: (Configurator) One needed for each intersection when available **Qty** 1

Push Button and Sign Braille Information

Button	Arrow Direction R/L	Button	Street Name (Street Being Crossed)
PB2-1	**R**	PB2-1	**Ellis Road NW**
PB2-2	**L**	PB2-2	**Ellis Road NW**
PB4-1		PB4-1	
PB4-2		PB4-2	
PB6-1		PB6-1	
PB6-2		PB6-2	
PB8-1		PB8-1	
PB8-2		PB8-2	

Custom Voice Message Details

Voice on Location and Walk Message(s) Please give phonetic pronunciation on difficult street names so that the message will be recorded correctly.

*Note that unless Street, Drive, Avenue etc…are absolutely necessary for intersection identification, it is recommended to not include them in the verbal message.

PB 2-1

Wait Message:

Wait to Cross | **Ellis** (Street Being Crossed) | **at** | **Edgewood** (Intersecting Street)

Walk Message:

Ellis (Street Being Crossed) | **Walk sign is on to cross** | **Ellis** (Street Being Crossed)

PB 2-2

Wait Message:

Wait to Cross | **Ellis** (Street Being Crossed) | **at** | **Edgewood** (Intersecting Street)

Walk Message:

Ellis (Street Being Crossed) | **Walk sign is on to cross** | **Ellis** (Street Being Crossed)

PB

Wait Message:

Wait to Cross | (Street Being Crossed) | **at** | (Intersecting Street)

Walk Message:

(Street Being Crossed) | **Walk sign is on to cross** | (Street Being Crossed)

PB

Wait Message:

Wait to Cross | (Street Being Crossed) | **at** | **(Intersecting Street)**

Walk Message:

(Street Being Crossed) | **Walk sign is on to cross** | (Street Being Crossed)

PB

Wait Message:
Wait to Cross ______ **at** ______
(Street Being Crossed) (Intersecting Street)

Walk Message:
______ **Walk sign is on to cross** ______
(Street Being Crossed) (Street Being Crossed)

PB

Wait Message:
Wait to Cross ______ **at** ______
(Street Being Crossed) (Intersecting Street)

Walk Message:
______ **Walk sign is on to cross** ______
(Street Being Crossed) (Street Being Crossed)

PB

Wait Message:
Wait to Cross ______ **at** ______
(Street Being Crossed) (Intersecting Street)

Walk Message:
______ **Walk sign is on to cross** ______
(Street Being Crossed) (Street Being Crossed)

PB

Wait Message:
Wait to Cross ______ **at** ______
(Street Being Crossed) (Intersecting Street)

Walk Message:
______ **Walk sign is on to cross** ______
(Street Being Crossed) (Street Being Crossed)

Accessible Pedestrian Signal (APS)
ORDER FORM
(Fill out one form per intersection)

Intersection: Edgewood Road NW & O Avenue NW

Project No.: **Total Quantity of Pedestrian Push Buttons** 8

Control Board: One needed for each intersection **Qty** 1

CCU: (Central Control Unit) One needed for each intersection **Qty** 1

CONFIG: (Configurator) One needed for each intersection when available **Qty** 1

Push Button and Sign Braille Information

Button	Arrow Direction R/L	Button	Street Name (Street Being Crossed)
PB2-1	**R**	PB2-1	**O Avenue**
PB2-2	**L**	PB2-2	**O Avenue**
PB4-1	**L**	PB4-1	**Edgewood**
PB4-2	**R**	PB4-2	**Edgewood**
PB6-1	**R**	PB6-1	**O Avenue**
PB6-2	**L**	PB6-2	**O Avenue**
PB8-1	**L**	PB8-1	**Edgewood**
PB8-2	**R**	PB8-2	**Edgewood**

Custom Voice Message Details

Voice on Location and Walk Message(s) Please give phonetic pronunciation on difficult street names so that the message will be recorded correctly.

*Note that unless Street, Drive, Avenue etc…are absolutely necessary for intersection identification, it is recommended to not include them in the verbal message.

PB 2-1

Wait Message:

Wait to Cross | **O Avenue** (Street Being Crossed) | **at** | **Edgewood** (Intersecting Street)

Walk Message:

O Avenue (Street Being Crossed) | **Walk sign is on to cross** | **O Avenue** (Street Being Crossed)

PB 2-2

Wait Message:

Wait to Cross | **O Avenue** (Street Being Crossed) | **at** | **Edgewood** (Intersecting Street)

Walk Message:

O Avenue (Street Being Crossed) | **Walk sign is on to cross** | **O Avenue** (Street Being Crossed)

PB 4-1

Wait Message:

Wait to Cross | **Edgewood** (Street Being Crossed) | **at** | **O Avenue** (Intersecting Street)

Walk Message:

Edgewood (Street Being Crossed) | **Walk sign is on to cross** | **Edgewood** (Street Being Crossed)

PB 4-2

Wait Message:

Wait to Cross | **Edgewood** (Street Being Crossed) | **at** | **O Avenue** **(Intersecting Street)**

Walk Message:

Edgewood (Street Being Crossed) | **Walk sign is on to cross** | **Edgewood** (Street Being Crossed)

PB 6-1

Wait Message:

Wait to Cross	**O Avenue** (Street Being Crossed)	**at**	**Edgewood** (Intersecting Street)

Walk Message:

	O Avenue (Street Being Crossed)	**Walk sign is on to cross**	**O Avenue** (Street Being Crossed)

PB 6-2

Wait Message:

Wait to Cross	**O Avenue** (Street Being Crossed)	**at**	**Edgewood** (Intersecting Street)

Walk Message:

	O Avenue (Street Being Crossed)	**Walk sign is on to cross**	**O Avenue** (Street Being Crossed)

PB 8-1

Wait Message:

Wait to Cross	**Edgewood** (Street Being Crossed)	**at**	**O Avenue** (Intersecting Street)

Walk Message:

	Edgewood (Street Being Crossed)	**Walk sign is on to cross**	**Edgewood** (Street Being Crossed)

PB 8-2

Wait Message:

Wait to Cross	**Edgewood** (Street Being Crossed)	**at**	**O Avenue** (Intersecting Street)

Walk Message:

	Edgewood (Street Being Crossed)	**Walk sign is on to cross**	**Edgewood** (Street Being Crossed)

2.11 – Traffic Signal Controller Cabinet

A. General Design Requirements

1. Traffic signal cabinet shall be NEMA TS-2 type 1.
   a. Base mount controller cabinets shall be Nema P size with 8 phase-16 load switch back panel and 15 inch cabinet riser. Pole mount cabinets shall be Nema M size with 8 phase-12 load switch back panel.
   b. Cabinet shall have a TS-2 detector rack with BIU, 16 vehicle detector inputs and four preemption inputs.
   c. Econolite Cobalt TS-2 type 2 controller (with 55 pin A connector) and EDI MMU2-LEip will be supplied by the City. Contractor will deliver signal cabinet to City Signal Shop for a 2 week testing period prior to installation.
   d. Cabinet shall be supplied with all necessary components for a fully operational traffic signal including network components. All components shall comply with any relevant Nema standards.
2. Cabinet Basic Construction. The controller and all associated equipment shall be housed in weatherproof metal cabinet of clean-cut design and appearance.
   a. Construction Material. The cabinet shall be constructed of sheet aluminum.
      1) The cabinet and riser shall be natural, brushed aluminum. All mounting attachments shall be natural, brushed aluminum or finished with two coats of high grade aluminum colored paint.
      2) Cabinet lifting eyes shall be installed on cabinet
      3) Door. A hinged door shall be provided permitting complete access to the interior of cabinet. When closed, the door shall fit closely to gasket material, making the cabinet weather and dust resistant. The door shall be provided with a strong lock and key.
         a) No. 2 key for cabinet door lock
      4) Door Stop. The controller cabinet door shall be provided with a stop and catch arrangement to hold the door open at angles of both 90 degrees and 180 degrees, ± 10 degrees.
   b. Cabinet shall be provided with a police door in the cabinet door using a skeleton key lock. Police panel shall have signal/off switch, flash/normal switch, auto/manual control switch and pluggable manual pushbutton. All switches must be labeled.
   c. Inside of cabinet door shall have a service panel with controller on/off, flash/normal, stop time on/off/normal and flash/normal switch. All switches must be labeled.
      1) Mounting Shelves. The cabinet shall contain two shelves, 10 inches deep. Top shelf for network switch and power supply (left side), detector rack and power supply (right side) top shelf shall have brackets for 1RU 19 inch rack device underneath. Bottom shelf for monitor, controller, pedestrian detector unit and MMU. Bottom shelf shall have slide out print drawer/laptop table.
      2) Mounting Screws. Screws used for mounting shelves or other mounting purposes shall not protrude beyond the outside wall of the cabinet.
      3) Outlet and Lamp. An electrical utility GFCI outlet shall be furnished and located in an accessible place. Cabinet shall be provided with led lighting to illuminate all parts of the cabinet interior during nighttime hours and controlled by a door actuated switch.
      4) Fiber tray, a wall mount fiber enclosure shall be mounted in the top left side of the cabinet. It shall be easily removable by loosening four mounting screws. Panduit FWME4
   d. Ventilation. A thermostatically controlled fan unit with a minimum rating of 100 CFM in 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 fan shall be adjustable. The fan 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. 12 inch by 16 inch pleated cloth type filters shall be used to cover the air intakes into the cabinet. These filters shall be easily removed and replaced.
   e. Connecting Cables, Wiring and Panels

1) TS-2 type 2 A connector, 55 pin
2) Cabinet shall have a SDLC cable for video detection controller unit. A jack to add a future SDLC cable shall be included.
3) Circuit breakers shall be used for all overload protection instead of fuses.
4) 8 AC receptacles in cabinet for network or detection devices, no GFCI feature.
5) Fan circuit shall be able to be de-energized without affecting signal operation (for fan replacement)
6) Surge suppression and line filter shall be included in power inlet panel
7) Clear plastic cover over power inlet panel shall be included

3. Guarantee. The equipment furnished shall be new, of the latest model fabricated in a first-class workmanlike manner from good quality material. The manufacturer shall replace free of charge to the purchaser any part that fails in any manner by reason of defective material or workmanship within a period of 18 months from date of shipment from the supplier's factory, but not to exceed one year from the date that the equipment was placed in operation after installation.
4. Wiring Diagrams and Documentation: two sets of paper cabinet prints shall be supplied with cabinet. PDF cabinet prints shall be supplied to the city by email or USB drive.
   a. Complete schematic diagram, accurate and current for unit supplied.
   b. Complete physical description of unit.
   c. Complete installation procedure for unit.
   d. Specifications and assembly procedure for any attached or associated equipment required for operation.
   e. Warranty and guarantee on unit, if any.
   f. Manuals, include any relevant manuals

2.12 – Video Detection System

A. The video detection system shall be the Iteris Vantage Next Video Detection System.
B. The system shall be composed of these principal items: the cameras, the field communications link between the camera(s) and the processor unit(s) along with any PC, video monitor or associated equipment required to set up the system.
C. The configuration will consist of the following components: Four cameras (unless otherwise specified in the Plans), mounting assembly(ies), one to four rack-mounted detector cards, card racks(s), field video monitor (minimum 9 inch screen), software and all associated equipment required to set up and operate in a field environment. Material provided by the Contractor shall include two sets of operations manuals and one service manual with schematics and parts list for out of warranty repairs.

2.13 – PTZ Dome Network Camera

A. The traffic monitoring system used on the project shall be AXIS Q6055-E Dome Network Camera System with mounting hardware or equivalent, and be fully compatible with the CITY’s existing system network.

2.14 – Ethernet Communication System

A. This specification sets forth the minimum requirements for an Ethernet based traffic signal interconnect and communications system. All work, equipment, and materials to provide a properly functioning Ethernet communications system shall be new and included.
   1. The fiber optic Ethernet communications equipment shall include: Comtrol RocketLinx ES8509-XT fully managed layer 2 switch.
   2. The system shall be fiber optic cable based, but may include interface equipment to change from fiber optic communication to twisted pair copper wire communication as shown in the plans. The system shall also include interface equipment and cabling for CAT-5e communications.

B. The breakout kits or termination boxes used to terminate each fiber cable in the cabinet shall provide for the separation and protection of the individual fibers with the buffer tubing and jacketing materials. The termination housing shall be installed within a wall or shelf mountable interconnect housing which shall provide for storing fibers, ample room for feed through cable, strain relief for multiple cables within unit, and accommodate ST compatible connectors. All fiber pigtails shall be terminated through ST connectors on the wall or shelf mounted interconnect panel. All terminations shall be ST type, ceramic core (outdoor connections), and plug into the provided controller unit internal fiber optic modem. Acceptable enclosures for combination termination/splice points shall be MIC024 or WDC012 enclosures or preapproved equal. Splices to pigtail fiber, where used, shall utilize fan out kit protection to the fiber, heat shrink tubing with metal bar reinforcement and 900 micron rated pigtail insulation. Splices to factory pigtails shall use pigtails that are rated for a minimum temperature range of 0°F to +150°F. In the absence of pigtails meeting this temperature rating, fibers shall utilize loose tube fiber in fan-out kit tubes and UniCam mechanical ST or epoxy approved connectors. These splices, fiber cable to pigtails, may be external to splice trays mounted internally to the enclosure, when shown on the wiring diagrams. All other splices, not specified to be installed external to the fiber splice tray, shall be installed in splice trays and be supported with heat shrink tubing. Acceptable splice trays include MIC024048 or 067 series or preapproved equal.

C. All equipment, terminations, connectors, terminal blocks, and any other hardware to construct the system shall be designed for outdoor use in typical traffic signal system conditions. All equipment shall include mounting brackets to secure the equipment in the cabinet.
Fiber optic cable shall be Prysmian FEDH1JKT12CE024E3.

2.15 – Service Pedestal and Back-to-Back Battery Back-up System

A. If set forth in the Plans, the Contractor shall supply and install a combination battery back-up, electrical service with meter and lighting controller. Additional features must include transfer switch for generator power (lockage in use), metered disconnect for traffic signal, and metered disconnect for street lighting. Dedicated conduits shall connect the unit with the adjacent signal pole base (for street lighting) and the designated polymer concrete hand hole (for traffic signal cabinet). The service pedestal shall be part of the continuously grounded system discussed in this specification.

B. The underground service distribution and control pedestals shall be constructed of anodized aluminum. The system shall provide uninterrupted, conditioned power (true pure sine wave) for the Traffic Controller Cabinet to eliminate Black-outs, Brown-outs, and Spikes on the signals and the control equipment. A typical intersection with a power outage, will operate as normal for 2 hours of run time and 8 hours of flash. Upon normal power resumption, the system shall recharge to 95% within 6 hours. Batteries shall be quick, hot swap replacement with no exposed terminals. The system shall monitor and record transient events and self-test the batteries, and provide local and remote data.

C. Service pedestal will include:
   1. Small and low profile with no exposed fasteners.
   2. Fabricated from anodized aluminum.
   3. Durable all welded construction.
   4. Vandal proof doors with hasp stress rated to 2000 pounds.
   5. The cabinet shall be factory wired and tested before shipment.
   6. UL approved copper cable busing and control wiring.
   7. Meets EUSERC requirements.
   8. Shall provide metered circuits up to 200 Amps.

D. Cabinets and power specifications:
   1. Dual Cabinets external dimensions: 20.5 inches wide by 50 inches high by 19.25 inches deep, excluding door handles.
   2. Cabinet shall be fabricated from 1/8 inch anodized aluminum.
   3. Internal parts shall be fabricated from 14 gauge cold rolled steel.
   4. Cabinet shall be all welded construction with welding materials specifically designed for the material used.

5. All fasteners, latches, and hardware shall be of stainless steel and all hinges shall be continuous piano style.
6. There shall be no exposed nuts, bolts, screws, rivets, or other fasteners on the exterior.
7. Removable back pan shall be mounted on four welded 1/4 inch studs.
8. Cabinet doors shall have 2000-pound stress rated hasp, welded to the cabinet and door.
9. Cabinets shall have fully framed side hinged outer doors with swagged close tolerance sides for flush fit with top drip lip and closed cell neoprene flange compressed gaskets.
10. Base mounting detail shall be identical to existing cabinets for emergency replacement.

E. Dead front Safety Door
1. Distribution and control panel shall have a hinged dead front panel with 1/4 turn latch and knurled knobs.
2. Dead front shall be hinged on the same side as the front door and shall open a minimum of 120 degrees.

F. Power Distribution Panel
1. Main breakers shall be 1 pole, 2 pole, 3 pole, or 4 pole, as appropriate for this installation, and in accordance with the local utility.
2. Provide separate metered main, metered lighting main, and disconnects as required.
3. There shall be no plug-in circuit breakers. Circuit breakers shall be industrial grade.
4. All branch circuit breakers shall be installed in a vertical position, handle up for ‘On’, handle down for ‘Off’.
5. All busing shall be U.L. approved copper THHN cable busing, fully rated.

G. Battery Back-Up System
1. Vandal-resistant construction.
2. 1400 VA, 950 Watts, Industry Standard run time 3 hours - all LED Intersection.
3. Typical Intersection (700 watts) run time 2 hours, with 6 to 8 hours of selected flash.
4. Inverter Tit-out housing for easy maintenance.
5. No tools required for inverter 110 contact connections and simple slide-in installation, weighs 28 pounds.
6. Full power bypass and isolation switches.
7. Transient voltage protection.
8. Power Analyzer with triple redundant Bypass
9. Conditioned power
10. Power Conflict Monitor with isolation and transfer module
11. Watchdog timer with redundant 5 ms delay and hard transfer to utility power
12. Smart slot communications I/O module.
13. RS 232 and USB ports for local or remote monitoring.
14. Intelligent battery management system with microprocessor controlled smart battery charger, automatic self-test, cell guard for longer life and faster recharge times.
15. 24V 18AH batteries AGM/VRLA (absorbed glass mat/valve regulated lead acid), compact, lightweight only 25 pounds
16. Seismically rated fixed position framed battery trays.
17. Quick swap hot battery replacement system.
18. Heavy duty smart safety battery connection system, 30A silver plated plugs.
19. Battery Manufacturer’s 2 year warranty.

H. Control Compartment
1. All components shall match existing components in use for maintenance of spare parts and known reliability.
2. The cabinet shall be completely prewired in the factory.
3. All control wiring is 19 strand No. 14 AWG THHN.
4. All terminals shall be permanently labeled.

I. Nameplates and Drawings
1. The function of circuit breakers, switches and other components as required shall be identified by laminated engraved plastic nameplates fastened with minimum of two 1/4 inch, No. 4-40 machine screws.

2.16 – LED Luminaires

A. The street light luminaire fixtures provided for installation on the combination traffic signal / street light poles shall be as follows:
   1. Series: Philips RoadFocus LED Series
   2. Lamp: RFL – 145W64LED4K
   3. Optical System / LED Type III Medium
   4. Voltage: Universal (120-277)
   5. Driver Options: DMG-OTL (Over the Life, driver pre-programmed to signal the end of lamp life)
   6. Luminaire options: API (ANSI / NEMA wattage label) and RCD (receptacle for a twist-lock photocell or shorting cap)
   7. Finish options: GY3 (gray)

2.17 – Equipment and Materials

A. Equipment and materials shall be of new stock unless the contract documents provide for the use of existing equipment, or equipment furnished by others. New equipment and materials shall be the product of reputable manufacturers of electrical equipment and shall meet the approval of the Engineer.

PART 3 EXECUTION

3.01 – General

A. The Contractor shall furnish and install all equipment and materials necessary for a complete and operative signal installation as shown on the plans and described in the contract documents. The Contractor shall perform all work required and furnish all labor, materials, equipment, tools, transportation and supplies necessary to complete the work in accordance with the contract documents.
B. The Contractor shall be a licensed electrical Contractor in accordance with City Ordinance and adherence to local Building Code shall be met.
C. The Contractor will be responsible for incidental sidewalk removal and replacement necessary to complete the signal construction. All waste material and debris shall be disposed of at a sanitary landfill at the Contractor’s expense.
D. All incidental parts which are not shown on the plans or specified herein, and which are necessary to complete the traffic signal, or electrical systems, shall be furnished and installed as though such parts were shown on the plans or specified herein. All systems shall be complete and in operation to the satisfaction of the Contracting Authority at the time of completion of the work.
E. The Engineer or his representative shall have full freedom to observe all phases of the work performed by the Contractor and to discuss all matters dealing with the quality and progress of the work.
F. The installation of the signals and signs shall be in conformance with the MUTCD, latest adopted revision.

3.02 – Qualifications, Service Calls, and Warranty

A. Contractor's personnel are required to be knowledgeable of the traffic signal controller operation and wiring. Controller manuals and wiring schematics will be provided to the Contractor for his use on the project. These documents must be returned undamaged at the end of the project.
B. The Public Works Department Traffic Engineering Division will provide part-time observation of the Contractor's work. The Division's representative will be available during normal working hours (7:00 A.M.-3:30 P.M.) to review the Contractor's work. Contractor shall provide four hours’ advance notice to the Division for review of the work. Any service calls or review of the Contractor's work outside of the Department's normal working hours will be billed to the Contractor.
C. The Traffic Engineering Division will continue to provide service call maintenance during the project. If it is determined that the malfunction was caused by the Contractor's work, then the Contractor will be billed for the materials, labor, and equipment required to correct the malfunction and/or damage.

3.03 – Concrete Foundations for Poles and Controller

A. Conform to Article 2525.03 of the Standard Specifications.
B. Excavations for foundations shall be made in a neat and workmanlike manner. Whenever the excavation is irregular, forms shall be used to provide the proper dimensions of the foundations below grade. Construction of the foundations may require hand excavation to verify location of utilities.
C. The material for the forms shall be of sufficient thickness to prevent warping or other deflections from the specified pattern. The forms shall be set level and means shall be provided for holding them rigidly in place while the concrete is being placed. When located within or adjacent to a continuous sidewalk area, the top of the pole foundations shall be set flush with the sidewalk or pavement surface.
D. All reinforcing bars, conduits, ground rods, and anchor bolts shall be installed rigidly in place before concrete is placed in the forms. Cap and protect conduit ends before placing concrete.
E. Anchor bolts for the signal poles or the controller shall be set in place by means of a template constructed to space the anchor rods in accordance with the manufacturer's requirements. The top of the bolts shall not vary more than 1/4 inch. The center of the template and the center of the concrete base shall coincide unless the Engineer directs otherwise.
F. The top of the base shall be finished level and the top edges shall be rounded with an edger having a radius of 1/2 inch. The exposed surface of the base shall have a wood floated surface finish. Exposed concrete surfaces shall be cured using white-pigmented curing compound or plastic film meeting the requirements of the Standard Specifications.
G. The bottom of the foundations shall rest securely on firm undisturbed ground. Where the foundation cannot be constructed as shown on the plans because of an obstruction, the Contractor shall use other effective methods of supporting the pole as may be designated by the Engineer.
H. After the concrete is placed in the form, it shall be vibrated with a high-frequency vibrator to eliminate all voids.
I. After the foundation has been poured, absolutely no modification of any sort may be made. If the anchor bolts, conduit, or any part of the foundation or base is installed in an incorrect manner as determined by the Engineer, the entire foundation or base shall be removed and a new foundation installed. The Contractor shall bear all costs of replacing work deemed unsatisfactory by the Engineer.
J. Unless otherwise specified, anchor bolts for poles where arms are to be perpendicular to the centerline of the street shall be installed so that a line through the center of one anchor bolt farthest from the curb and extended through the center of the adjacent anchor bolt closest to the curb will be perpendicular to the centerline of the street to within two degrees of arc unless otherwise specified.
K. Prior to setting poles, the anchor bolts shall be covered in such a manner as to protect them against damage and to protect the public from possible injury.
L. Each base location shall be approved by the Engineer prior to construction. Base dimensions shown on the plans are minimum dimensions and based on stable soil conditions. Should extremely loose or sandy soil be encountered, the Contractor shall contact the Engineer for necessary base alterations.
M. Where shown on the plans, the Contractor shall remove the top of 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 with mechanical compaction equipment meeting the requirements for backfilling conduit. The upper 6 inches of the removal area, if outside the proposed pavement, shall be backfilled with black dirt and seeded.

3.04 – Hand holes

A. Hand holes shall be a precast unit conforming to the requirements of the plans.
B. The ends of all conduit leading into the hand hole shall fit approximately 2 inches beyond the inside wall. A drain conforming to the dimensions shown on the Plans shall be constructed in the bottom of the hand hole unless otherwise specified.

C. Frames and covers for hand holes shall be set flush with the sidewalk or pavement surface. When installed in an earth shoulder away from the pavement edge, the top surface of the hand hole shall be approximately 1 inch above the surface of ground. When constructed in unpaved driveways, the top surface of the hand hole shall be level with the surface of the driveway.
D. Openings for conduit access shall be drilled to match the outside diameter of the conduit.
E. Grout conduit access after installing conduit.

3.05 – Conduit

A. Conduit shall be placed between structures as identified on the plans.
B. Conduit shall be installed without change in direction directly from one structure to another, unless approved by the Engineer. Change in direction may be considered for physical restrictions such as right-of-way restrictions, utilities, location of roadway slopes, retrofitting existing conduit stubs, and certain short sections of conduits.
C. Nipples shall be used to eliminate cutting and threading where short lengths of conduit are required. Where it is necessary to cut and thread steel conduit, exposed threads will be field galvanized.
D. All conduit and fittings shall be free from burrs and rough places. Standard manufactured elbows, nipples, tees, reducers, bends, couplings, union, etc. of the same materials and treatment as the straight conduit pipe shall be tightly connected to the conduit.
E. All conduit and fittings shall be free from burrs and rough places. Standard manufactured elbows, nipples, tees, reducers, bends, couplings, union, etc. of the same materials and treatment as the straight conduit pipe shall be tightly connected to the conduit.
F. All conduit placed for future use shall be threaded and capped with threaded metal pipe caps.
G. All conduits shall drain, except for specific locations approved by the Engineer. Contractor will not be allowed to bend conduits upward to accomplish the conduit clearances shown on the hand hole details.
H. All conduit openings shall be sealed with an approved sealing compound after the cables are in place. This compound shall be a readily workable soft plastic. It shall be workable at temperatures as low as 30°F, and shall not melt or run at temperatures as high as 300°F.

3.06 – Trenching and Backfilling for Traffic Signals

A. Secure written approval of the City Forester/ Arborist prior to any trenching or excavation within the drip line of any tree.
B. Trenches shall be excavated to such depth as necessary to provide 12 inch to 18 inch cover over the conduit. All cinders, broken concrete or other hard abrasive materials shall be removed and shall not be used for backfill. The trench shall be free of such materials before the conduit is placed. No conduit shall be placed prior to inspection of the trench by the Engineer.
C. All trenches shall be backfilled as soon as possible after installation of conduit. Backfill material shall be deposited in the trench in layers not to exceed 6 inches in depth and each
D. layer shall be thoroughly compacted before the next layer is placed. Hard materials shall not be placed within 6 inches of the conduit.
E. Whenever excavation is made across parkways, gravel driveways, or sodded areas, 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, and base courses and bituminous surfaces shall be replaced with new materials and the cost shall be incidental to the work.

3.07 – Pushed Conduit

A. It is intended that all conduit be placed without disturbing the existing pavement, and the term "pushed" is used. "Pushed" conduit shall be placed by jacking, pushing, boring or any other means necessary to place the conduit without cutting or removing pavement.
B. Removal of pavement will require prior approval of the Engineer. Replacement of removed pavement will be done according to plan details and no additional payment will be made.
C. Plan quantities for pushed conduit include at least two feet of pushed conduit behind each curb.

D. The maximum conduit depth at hand holes for all conduits, including pushed conduit, is as shown on the plans. Contractor must push a mole (without conduit) at least four times before consideration will be given to allowing an upward bend in the conduit.

3.08 – Electrical

A. All conductor cable combinations shall be shown on the plans. No substitutions will be permitted. Each signal head shall be wired separately from the hand hole compartment in the pole base to the signal head.

B. The signal cable color codes shall be as follows:

5-Section Traffic Signals	
Red Ball	Red
Yellow Ball	Orange
Green Ball	Green
Yellow Arrow	W/Bk
Green Arrow	Black
Sig. Common	White
Spare	Blue

4-Section Traffic Signals	
Red Arrow	Red
Yellow Arrow	Orange
Flashing Y/Arrow	W/Bk
Green Arrow	Green
Sig. Common	White
Spare	Blue
Spare	Black

3-Section Traffic Signals	
Red Ball	Red
Yellow Ball	Orange
Green Ball	Green
Sig. Common	White
Spare	Black

Pedestrian Signals	
Walk	Green
Don't Walk	Red
Sig. Common	White

C. One electrical splice in the hand hole compartment of the pole base will be allowed for the signal circuit wiring. All signal circuit cable runs shall be one continuous length of cable from the connections made in the hand hole compartment of the signal pole bases to the terminal compartment in the controller base.

D. Conductor groupings and splicing's may be made in the terminal compartment in the controller cabinet.

E. The loop detector lead-in cable shall be one continuous length of cable from the terminal compartment of the controller cabinet to a splice made with the loop detector wires in the first hand hole or pole base hand hole compartment provided adjacent to the loop detector. Details of the loop detector splices are shown on the plans.

F. Cables shall be pulled through conduit by means of a cable grip designed to provide a firm hold upon the exterior covering of the cable or cables, with a minimum of dragging on the ground or pavement. This shall be accomplished by means of reels mounted on jacks or other suitable devices. Frame-mounted pulleys, or other suitable devices shall be used for pulling the cable out of conduits into hand holes. Only vegetable lubricants may be used to facilitate the pulling of cable.

G. Each signal cable shall be identified with an identification tie in the controller cabinet, hand holes, pole base hand hole, pedestal hand hole and at any splice or junction location. Identification ties shall be provided both on the cable from the controller and the cables leading to the heads for a splice in a pole base hand hole. Identification shall be permanent and water-proof. Once installed, the tie shall not be removable except by cutting it loose from the cable.
Identification ties shall be marked as follows:
   1. Heads: Head number, number of sections
   2. Loops: Loop number, direction and location (stop lines, advance, or left turn loop)
   3. Pedestrian push button: Location, street crossing

H. Cable slack shall be 4 feet in hand holes, 2 feet in signal bases and in the terminal compartment of the controller base. No slack will be allowed in the loop detector lead-in cable after the initial splice.

I. Connectors shall be of the proper size for the number and size of the wires being connected.

J. Clean wire ends thoroughly after the insulation is stripped off to insure complete contact with another wire or the connector. Discard section of cable if strands are damaged when insulation is

removed. Nicked or damaged conductor strands will not be permitted inside of connectors. Loose wire ends shall not be used as "shims" to make a connection.

K. Do not apply electrical tape to the finished connections. Extend signal cable insulation beneath the insulated portion of the connector. Redo any connection with exposed bare wire.
L. Arrange covered connections so they will not be in contact with the metal poles. Connections in the poles shall be pointed up to prevent accumulation of moisture in the connection.
M. Loop detector splices shall be capable of satisfactory operations under continuous immersion in water.
N. Cable connections in signal heads and controller cabinets shall be made at the terminal blocks provided for this purpose. All stranded wires inserted under a binder head screw shall be equipped with a solderless pressure type spade connector with a pre-insulated shank. All solid wire shall have an eye and shall not have a terminal connector.
O. Service cable shall be continuous from the disconnect switch located on the service pole to the terminal compartment of the controller cabinet.
P. Interconnect cable shall be continuous from controller to controller.
Q. A tracer wire shall be installed as incidental in all conduits with signal cables, detector lead-in cables, or communication cables. The tracer wire shall be identified in the controller cabinet, hand holes, and poles by means of identification tags. The tracer wire shall be spliced in the hand holes to form a continuous network.
R. If approval is granted by the Engineer for use of PVC or HDPE conduit carrying signal cable, ground wire shall be installed in all such conduit, and shall be incidental.

3.09 – Pole Erection

A. All poles are to be erected vertically and securely bolted to the cast-in-place concrete foundations at the locations shown on the plans.
B. Leveling shall be accomplished by the use of nuts on each anchor bolt. One nut shall be turned on each anchor bolt and the pole placed in position on these nuts. The top nuts shall then be placed loosely and the pole adjusted to the vertical position by adjusting both the upper and lower nuts.
C. After the pole is securely fastened, install stainless steel mesh in the area between the pole and the base. The material and the method of attachment shall be approved by the Engineer.
D. Each pole shall be grounded from the pole to the foundation ground rod by a No. 6 AWG bare copper ground wire.
E. Poles shall be placed so that modifications and/or attachments are correctly oriented, as indicated on the plans.
F. The foundations must be given 7 days to cure before poles are erected. The centers of the poles are to be set back from the curb by distance shown on the plans. Poles shall be erected so that they are plumb with traffic signals installed, in line, and all the same relative height above the centerline of the street and with the mast arms correctly oriented as shown on the plans.
G. Poles must be erected so that they are plumb with traffic signal heads. The manufacturer recommendation for raking should be observed when setting the pole to assure that it is plumb when the load is applied.
H. Mast arm assemblies shall be furnished and installed by the Contractor, unless otherwise stated in the Plan Documents. When pre-used painted mast arm assemblies are specified, the Contractor shall prime and paint the mast arm assemblies with the following method:
    1. Remove all rust, scale, and loose paint from the surface by sanding or power tool cleaning (SSPC-SP-3). Contractor to use care when power tool cleaning to avoid burning, polishing, or grinding surface dirt into the existing paint surface. Hand tool cleaning (SSPC-SP-2) will be allowed only in areas accessible to power tool cleaning.
    2. Remove all chalking, dirt, and other foreign material from the entire surface by application of petroleum solvent (i.e. paint thinner, mineral spirits, etc.) and wiping the entire surface with clean rags.
    3. All bare metal surfaces exposed by the cleaning operation shall be spot primed the same day to avoid flash rusting.
    4. After the primed areas have dried, apply one coat of finish paint.
    5. Primer and paint must be approved by the Engineer.

3.10 – Signals

A. All signal faces and indicators shall be furnished by the Contractor and installed as shown on the plans. 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 are required when the view of the pole mounted signal indication is blocked. Pedestrian pushbuttons shall be installed on the face of the pole in 90 degree increments with respect to the mast arm. The pushbutton shall be located on the pole face so the arrow on the pushbutton sign directs pedestrians to the appropriate crosswalk.
B. Brackets for pole mounted signal and pedestrian heads shall be installed by drilling and tapping the pole. Stainless steel banding shall not be allowed.
C. All programmable visibility LED signal heads shall be properly masked or programmed to limit their field of view as directed by the Engineer.
D. Back plates shall be installed and properly secured for the traffic signal heads.
E. All signal heads shall be kept securely covered until such time as the signals are put into operation.
F. The location of signal heads in which the view of the indications is blocked or partially blocked by utility poles, trees or other 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.

3.11 – Controller Cabinet

A. The controller cabinet shall be mounted 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.
B. All field wiring must be directly attached to the wiring lugs. Attachment of wiring shall be in a neat and workmanlike manner.
C. All conduit openings in the controller cabinet shall be sealed with an approved sealing compound. This compound shall be a readily workable at temperatures as low as 30°F and shall not melt or run at temperatures as high as 300°F.
D. All wiring diagrams, service manuals, instructions for installing and maintaining the equipment and advice as to timing and operation shall be delivered to the Engineer in good condition.
E. The Engineer or his representative shall inspect the installation before activation and shall be present at the time the controller is activated to assure that the controller is installed in accordance with the manufacturer's recommendations.

3.12 – Ground Rods

A. Ground wires shall be connected to ground rods with one piece nonferrous clamps which employ set screws as tightening devices. Connections to ground rods need not be taped.
B. Each steel pole or pedestal shall be firmly connected to the ground rod provided, by means of the grounding terminal as specified. Placing the ground wire under an anchor bolt nut, anchor bolt cover, or similar device will not be permitted.

3.13 – Fiber Optic Cable Splicing

A. The Contractor shall submit a splicing plan to the Engineer for review and approval. Approval of the splicing plan shall occur prior to any splicing of fiber optic cable. The contractor's splicing plan shall include all information required to adequately depict splicing locations, breakout of buffer tubes, breakout of individual fibers, color coding, and splice tray layout. Splicing plan details should reference locations that are consistent with the locations defined elsewhere in the specification and on the plans.
B. The Contractor shall cut only the fibers to be terminated/spliced at designated location. Unused fibers or fibers that are continuous through a splice location are to be coiled, labeled and left

loose in the tray. Mid-sheathed fibers should be trayed last as to allow easy access in the future for splicing and label placed at the center of the storage coil.

C. All optical fiber splices including pigtail splicing at fiber distribution panel shall be fusion type splices utilizing heat shrink protection as opposed to bare fusion splices. Alignment shall be via fiber cores and not via fiber diameters. Mechanical splices shall not be permitted.
D. Splice all optical fibers, including spares, to provide continuous runs. Splices shall be allowed only in equipment cabinets except where shown on the plans.
E. Make all splices using a core-alignment fusion splicer that automatically positions the fibers using the Light Injection and Detection (LID) system. Provide all equipment and consumable supplies.
F. Secure each spliced fiber in a protective groove. The use of heat shrink wrap or equivalent protection is required.
G. Use a different splice tray for each buffer tube color. If an enclosure contains multiple buffer tubes of the same color, but none of the fibers in one of the tubes are spliced to fibers in other tubes of the same color, use a separate splice tray for that tube. Trays should be labeled with counts and the direction of the cable.
H. Termination splices shall join the fibers in the F/O cable span to the fibers in pigtails. The termination splices shall be placed in a splice tray and the splice tray(s) shall then be placed in the fiber distribution panel. The individual fibers shall be looped one and a half full turns on the short side and two full turns on the long side within the splice tray to avoid micro bending. A 2 inch minimum bend radius shall be maintained during installation and after placing in the optical fiber splice tray. Each fiber shall be individually restrained in a splice tray. The optical fibers in buffer tubes and the placement of the optical fibers in the splice tray shall be such that there is no discernable tensile force on the optical fiber.
I. All fiber cables shall be labeled at all splice locations with permanent machine printed vinyl markers. Labels shall identify the next splice and segment destination end of the fiber optic cable.
J. The overall system mean loss of all splices shall not exceed 0.05 dB per splice. No splice may exceed 0.10 dB loss. Any splice tested at greater than 0.10 dB must be re-cleaved and re-spliced. The Contractor must submit to the Engineer a record of estimated splice loss from each fiber optic splice identified by location and fiber number. This record must be recorded at the time of the splicing function. Hand-written test results are not acceptable. All data must be provided in Microsoft Excel format at the completion of the splicing. After 3 splice attempts and the loss is 0.2 dB or less the strand(s) is(are) to be labeled as "Usable but Out of Spec".

3.14 – Fiber Optic Cable Splice Testing

A. After splicing is complete, each fiber optic strand shall be tested and a test results printout sheet shall be furnished to the Engineer. The tests shall be conducted with an OTDR and a Power Meter.
B. The test shall be performed after the final cable termination has been completed and each strand has been installed in the fiber termination panel coupler. The test shall be of the "Basic Link" from termination panel to termination panel. Patch cables utilized for the test equipment connections are not to be included in the total dB loss.
C. Testing of each fiber link test shall follow this general procedure:
D. Calculate the maximum allowable loss for the completed link, both at 1310 nm and at 1550 nm. Use the following formula:
   Maximum link loss = (Fiber length in fee.) x (0.35 dB for 1310 nm and 0.25 dB for 1550 nm) + (Number of fusion splices) x (0.05 dB) + (Number of connections) x (0.5 dB)
E. Provide this calculation to the Engineer along with the test results.
F. Calibrate an optical loss test set and provide evidence satisfactory to the Engineer that the set produces accurate results at both wavelengths. This can be a demonstration that the set correctly measures the loss of a test fiber whose loss is known.
G. Use the test set to measure the loss of the link under test. Record the result at both 1310 nm and 1550 nm.
H. Testing of complete terminated and spliced fiber shall be conducted on each strand for loss and reflection using an Optical Time Domain Reflectometer (OTDR) and optical power meter.
   1. Acceptable losses:
      a. Mated connection pair: Less than 0.5 dB.

b. Per splice (if splicing is allowed): Less than 0.1 dB
c. Cable loss: Per manufacturers performance guarantee (in dB/km).

2. The tests will be performed bi-directionally from each site and the appropriate information recorded on the approved form. The fiber traces shall be saved and labeled in accordance to section tested. In addition, bi-directional fiber span loss measurements shall be taken and recorded on the approved form between each site. The fiber span loss measurements will be taken with a power-loss meter and light source capable of 1310 nm and 1550 nm. Prior to each test, the fiber termination shall be cleaned using a CLETOP (or equivalent) fiber cleaner. All test results will be turned over to the Owner at the completion of the tests. Documentation shall be in the form of printed forms, OTDR traces, and electronic copies. The owner will supply site naming schemes to avoid confusion of multiple sites.
3. No defective fiber strands are acceptable. Cables containing non-repairable defective strands shall be replaced at the installation contractor's expense. Contractors shall take whatever corrective action is required including, but not limited to, splice replacement or termination replacement to achieve a loss less than the calculated maximum. The City shall be responsible for the coordination of the replacement.
4. Each test result shall indicate cable number, test date, and tester name.

I. All test results shall be submitted in a neat, clean organized nature in a three-ring binder. The test sheets shall be divided by interconnection center and in numeric order. Dividers shall be placed between each interconnection center's test sheets. Test result data files are also to be submitted in electronic form along with reader software.

3.15 – Equipment Testing

A. When the Contractor's work is complete and the project is open to normal traffic, the Contractor shall notify the Engineer in writing the date the signal will be ready for testing. City procedure for operation of new traffic signal installations will apply, unless expressly modified by the Engineer.
B. Initial traffic signal timings and timing adjustments will be provided by the Engineer. The Contractor shall be responsible for testing and programming all equipment. At least ten working days prior to planned turn on of the signal, the Contractor shall provide Traffic Engineering the opportunity to review the equipment setup. Any errors or omissions in the setup will be corrected by the Contractor prior to placing the signal in operation.
C. Upon concurrence of the Engineer, the Contractor shall place the signal in operation for a consecutive 30 day test period. Any failure or malfunction of the equipment supplied or installation performed by the Contractor shall be corrected at the Contractor's expense and the signal tested for an additional 30 consecutive day period. This procedure shall be repeated until the signal equipment has operated satisfactorily for 30 consecutive days.
D. If the signal is to operate independently of other signals or signal systems, it shall be tested as a single installation.
E. If the signal is part of a system, the test period shall not be started until all signals in the system are ready to be tested. The system shall be tested as a unit.
F. The Contractor shall initiate correction of any failure malfunction of the signal installation within 24 hours of notification by the Engineer. The Engineer will correct any failure or malfunction of the signal installation not investigated by the Contractor within the above time period, and will deduct its expenses from the Contractor's final payment.
G. Ground testing shall conform to Article 2523.03 of the Standard Specifications.

3.16 – Clean-Up

A. Upon completion of the work in this special provision, remove from the site all rubbish, trash debris resulting from operations. Leave the site in a neat and orderly condition.

PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.01 – Method of Measurement

A. Measurement for Traffic Signalization will be lump sum.

4.02 – Basis of Payment

A. Payment for Traffic Signalization shall be full compensation for supplying all equipment, labor, and materials necessary to install, erect, and operate a complete, fully functional traffic signal system, including but not limited to traffic signal poles, mast arms, bases, signal heads, luminaires on combination street light/signal poles, wiring, conduits, hand holes, controllers, cabinets, coordination with utilities, vehicle detection system, battery back-up system, any Ethernet communication equipment, testing, and all other miscellaneous hardware, software or any other items necessary to complete the traffic signal system in place.