

**PART 700
TRAFFIC SIGNALIZATION**

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SECTION 701 - GENERAL

701.1 DESCRIPTION

This specification is intended to describe the method and construction requirements for the installation of a traffic signal. The installation shall include all poles, bases, cabinets, controllers, cables, conduits, service boxes, junction boxes, wiring, signal heads, detectors, and other miscellaneous parts. Part 700 is separated into three parts: 701-General, 702-Construction Requirements, 703-Materials.

701.2 CONTRACTOR RESPONSIBILITIES

The Contractor shall be responsible to furnish and install all equipment necessary as designed for the complete and satisfactory operation of the traffic signal, whether said equipment is specifically mentioned or not.

The Contractor shall contact all local agencies having jurisdiction over such installations and acquire any permits or licenses that may be required. Copies of any permits or licenses shall be supplied to the Engineer prior to beginning any construction or installation. The Contractor shall comply with all local ordinances, National Electrical Code (NEC), and applicable building codes.

The Contractor shall have a licensed journeyman electrician on site while traffic installation work is performed.

The Contractor shall notify the appropriate power company prior to any permanent service connection or attachment to determine the proper type and method of hook-up or installation. Direct costs for permanent electrical service and monthly usage will be paid by the City. The Contractor shall work with the City and power company to verify new electrical service is in the City's name.

The Contractor is responsible for any temporary electrical service required for construction (such as a job trailer). Temporary service will not be billed to the City and will be borne by the Contractor.

The Contractor shall arrange for supplier of the major items of electronic equipment to have a representative at the site during signal turn-on. Energizing of signal (turn-on) to occur Monday - Thursday, 9:00 AM - 3:00 PM unless specifically approved otherwise by the Engineer.

The Contractor shall notify any utility companies which may have facilities in the work area. The Contractor shall determine any conflicts with existing utilities prior to initiation of construction. The Contractor shall contact the Engineer upon determination of any utility conflicts. Adjustments in elevation of service boxes shall be the responsibility of the Contractor.

701.3 CONSTRUCTION DETAILS, SPECIFICATIONS, AND CONTACT INFORMATION

701.3.1 Construction Details, Specifications and Ranking

Traffic signal specifications (Part 700) may be found online at:

<https://www.wichita.gov/PWU/Pages/Regulations.aspx>

The Contractor shall notify the Engineer of any discrepancy related to the work being performed. If a discrepancy between or among the following contract documents occurs, the governing ranking or order of precedence is:

- a. Info at Prebid Meeting / Addendum(s)
- b. Plans
- c. Project Special Provisions
- d. Special Provisions
- e. Standard Specifications

701.3.2 Contact Information

If specific contact information is not provided on the plans, Engineering and the Signal Maintenance Department may be contacted at the locations below. At any time, a Contractor enters an existing signal cabinet, the signal maintenance department at CMF must be contacted.

City of Wichita - Engineering

455 N Main, 8th Floor
Wichita, KS 67202
316-265-4501

Central Maintenance Facility (CMF)

1801 S McLean Blvd
Wichita, KS 67213
316-268-4013

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SECTION 702 – CONSTRUCTION REQUIREMENTS

702.1 GENERAL

All incidental parts which are not shown in the Plans or in the Specifications and which are necessary to complete the traffic signal installation shall be furnished and installed as though such parts are shown in the Plans or specified herein. The traffic signal system shall be complete and in operation to the satisfaction of the Engineer and the maintaining agency at the time of acceptance of the work. All signs, signals, and markings shall conform to the latest edition of the Manual on Uniform Traffic Control Devices (MUTCD).

702.2 CERTIFICATION OF CONTRACTOR PERSONNEL

All traffic signal installation work shall be done by, or in the presence of and under the responsible charge of an employee of the Contractor who holds a Level II Traffic Signal Field Technician or Level II Traffic Signal Construction Technician certification which has been granted by the International Municipal Signal Association (IMSA), or an equivalent certification approved by the Kansas Department of Transportation or City of Wichita.

702.2.1 Requirements

Before starting work, the Contractor shall provide the Engineer with the names of the Level II Traffic Signal Field Technician and/or Level II Traffic Signal Construction Technicians who have been assigned to perform traffic signal related work, and a photocopy of each such person's certification card. If the Level II Traffic Signal Field Technician or Level II Traffic Signal Construction Technicians are dismissed from the work, all traffic signal installation work shall cease until the names and photocopies of certification cards for replacement personnel are provided to the Engineer.

702.3 TRAFFIC SIGNAL MATERIAL LIST

Before commencement of installation of the traffic signals, the Contractor shall submit, for approval or rejection by the Engineer, a list of traffic signal materials proposed for the installation. Partial submittals will be accepted. It is the Prime Contractor's responsibility to review all shop drawings and other required submittals prior to submitting to Engineer. The Engineer will not review submitted documentation until Prime Contractor's review is complete. See the materials section of these specifications for the basis of acceptance. The list should be submitted as soon as practical. Materials approved for use are included in the [Part 703](#) of the City of Wichita Standard Specifications.

702.4 SUBMITTALS

Submit one electronic copy of each submittal group to the Engineer for review and approval. Include in each submittal sufficient information and details to permit full evaluation of each item. Submittals, which in the Engineer's judgment do not permit proper evaluation, will not be reviewed. Take care to address all requirements of the Contract Documents in the submittal data. Leave nothing to assume. Address the functional and technical interrelationships among the various items in detail.

The Engineer reserves the right to reject incomplete or unclear submittals. Identify the materials on the list by the contract project number, item description, catalog part numbers, catalog cuts, shop drawings, trade names, and schedules or other pertinent information. Clearly indicate the materials from any catalog cuts. Note any material designation used in the Contract Documents on the materials list. Submit all manufacturer product sheets for review and approval.

For each item, include in the documents all information necessary to determine product specification compliance. Clearly indicate, on the documentation, the exact model number, accessories, and options that are being proposed for use. If standard manufacturer documentation does not specifically address all the product requirements, then obtain a letter from the manufacturer certifying compliance with each referenced requirement that is not indicated on the standard documentation. If reprinted literature, such as catalog cut sheets, is used to satisfy some or all of the submittal data requirements, do not include any statements on the literature which conflict with the Contract Documents. Cross off and initial any such statements. Explain how specifications shall be met pertaining to items changed from the literature.

702.4.1 Submittal Schedule and Review Periods

Submit product data submittals and shop drawings in a timely manner to allow for job completion within the contract working days. For each submittal, plan for any submittal information to be in the hands of the Engineer for up to 15 business days. Obtain final approval, in writing from the Engineer, on all items within the submitted documentation. No time extensions will be granted as a result of having to resubmit items for review or having to make any modifications necessary to any submitted documentation. Review of the submittal data by the Engineer will not relieve the Contractor from obligation to furnish and install the work in accordance with Contract Documents.

702.5 LOCATION OF UNDERGROUND UTILITIES

The plan location of underground utilities is not guaranteed. Additional existing utilities may also be encountered. The Contractor shall have all underground utilities located and marked before beginning any construction excavation and will be required to work around any existing utilities within the right-of-way which do not conflict with the proposed construction. The Contractor will be fully responsible for all damages resulting by failure to properly locate and preserve all underground utilities.

702.6 NOTIFICATION OF LOCAL POWER COMPANY

The Contractor shall notify the local power company prior to beginning work to determine the proper type and method of hook-up for the particular location. The Contractor shall be coordinate with the City to place permanent service in the City's name for the location shown on the plans. Any temporary services required, such as a job trailer, will be the Contractor's responsibility.

702.7 STAKING OF POLES, PEDESTALS, PULL BOXES, CONTROLLER, AND LOOP LOCATIONS

The locations for service enclosures, millbanks, signal poles, pedestals, service boxes, junction boxes, controller, and detector loops shall be staked by the City. The Contractor shall coordinate and schedule staking with the City with advanced notice. Staked locations shall be approved by the Engineer prior to construction of each item. This work shall be included in the lump sum bid item Traffic Signal.

702.8 TRAFFIC SIGNAL IMPROVEMENT POLICIES

The work included in this project may involve replacement and/or modification of existing traffic signal equipment at a location which is presently controlled by operating traffic signals. The following policies are to be observed during the proposed modifications and improvements:

702.8.1 Existing Operation

Unless otherwise noted in the Plans, the Contractor shall provide continuous operation of the traffic signals during the signal modifications and improvements, except for shutdowns, to allow for alterations as required for installation of the proposed improvements.

702.8.2 Periods of Disruption

Some periods of disruption of the existing signal operation can be tolerated during installation of the proposed improvements; however, the Contractor shall coordinate any planned disruption of signal operations with the Engineer at least 48 hours before such disruption of operations.

702.8.3 Disruption Times

Planned disruption of signal operations shall be limited to the hours between 9:00 AM and 3:00 PM, unless otherwise noted in the Plans or approved by the Engineer. Traffic control during signal disruptions shall be provided as directed by the Engineer. The signal controls shall be operable during all other periods.

702.8.4 Existing Wiring

All existing wiring within existing controller cabinets shall be identified by the Contractor and each conductor properly labeled prior to de-energizing the existing controller to install the proposed modifications and improvements. See Section [702.21](#) for labeling requirements.

702.8.5 Emergency Flash / Flashing Mode

Traffic signal shall operate in an all-red flashing mode for all signal phases for alternate operation of

the traffic control signal during a period of failure, using flashing mode or manual control, or manual traffic direction by authorized personnel as required by traffic volumes or congestion, or by erecting other traffic control devices. Pedestrian phases shall be dark.

702.9 SALVAGED EQUIPMENT

702.9.1 Reinstalled

When salvaged equipment is to be reinstalled, the Contractor shall furnish and install all necessary new materials and equipment including anchor bolts, nuts, washers, concrete, etc. required to complement the salvaged equipment in the new installation.

702.9.2 Not Reinstalled

When salvaged equipment is not to be reinstalled, it shall be delivered undamaged to the City of Wichita or respective owner. If not otherwise identified on the plans, equipment should be delivered to the signal maintenance department at the Central Maintenance Facility (CMF) at 1801 S McLean Blvd, Wichita, KS 67213. The Contractor shall schedule the delivery with Traffic Signal Maintenance a minimum of 24 hours in advance. The stored equipment shall be the responsibility of the Contractor until delivered to the owner.

702.10 REMOVAL OF EXISTING FOUNDATIONS

Existing foundations for traffic signal poles, pedestals, service holes, junction boxes, and controllers shall be removed a minimum of 24 inches below finished grade and shall be backfilled with excavated material mechanically compacted to a density equal to or greater than ninety percent (90%) of standard density. Locations where removal is equal to or greater than seven feet (7'), the removal may be backfilled with excavated material compacted to ninety percent (90%) of standard density or consolidated by flushing and vibrating upon approval of the Engineer.

702.11 CONDUIT INSTALLATION

Conduit shall be installed per standard details and as noted below. The conduit shall be of the type and size stated in the Plans. If the Plans do not specify the type of conduit, the conduit shall be galvanized rigid steel conduit (GRC). Conduit shall be of one material type and straight between outlets. 90-degree elbows or sweeps shall not be used unless approved by traffic maintenance or traffic engineering.

Conduit runs shown on the plans are for bidding purposes only and may be changed with permission of the Engineer to avoid underground obstructions. At no point should a continuous run of conduit exceed 135 degrees.

702.11.1 Conduit under Existing Pavement

Conduit under existing pavement, sidewalk, or driveways shall be installed using an approved jacking or boring method.

702.11.2 Above Ground Conduit

All electrical conduits installed above ground shall be metallic. Conduit attached to bridges shall have expansion fittings installed at the end of the bridge and at each expansion joint on the bridge. Any attachments to bridges or other structures must be approved by the City of Wichita Engineering.

702.11.3 Galvanized Rigid Steel Conduit (GRC)

All metallic conduits shall be electrically bonded by a grounding bushing and ground wire as detailed in the Plans. Unless otherwise notes, Galvanized Rigid Steel Conduit (GRC) shall be used for all traffic signal underground conduits.

702.11.4 High Density Polyethylene Conduit (HDPE)

HDPE conduit shall be continuous from outlet to outlet, with no splices allowed. Bend radii shall not exceed the manufacturer's recommendations. HDPE shall only be used when specified in the plans for special installations or for the overhead lighting circuit.

702.11.5 Polyvinyl Chloride (PVC)

The PVC conduit joints shall be made in accordance with the manufacturer's recommendations. PVC shall only be used when specified in the plans for special installations.

702.11.6 Empty Conduits

Cap or plug open ends of conduits placed for future use with watertight mechanical plugs, duct seal, or approved cap. Sealing conduit with expandable foam or tape is not permitted. After cleaning, place a pull rope in all empty conduits.

702.11.7 Joints and Bends

The ends of all conduits shall be well reamed to remove burrs and rough edges. Field cuts shall be made square and true so that the ends will butt or come together for the full diameter thereof. Slip joints or running threads will not be permitted for coupling conduit. When a standard coupling cannot be used, approved threaded union shall be used. The threads on all conduits shall have an excellent quality anti-seize compound for this intended purpose and material. All couplings shall be fitted and tightened until the end of the conduits are brought together. Where coating on conduit has been injured in handling, or installing, such injured places shall be thoroughly painted with a zinc-enriched galvanizing paint.

All conduit ends shall be threaded and capped with standard pipe caps until wiring is started. When caps are removed, the threaded ends shall be provided with approved conduit bushings.

The location of ends of all conduit for future electrical circuits in structures shall be marked by a "Y" at least three inches (3") high cut into the face of curb, sidewalk, gutter, or wall directly above the conduit.

Conduit bends, except factory bends, shall have a radius of not less than six (6) times the inside diameter of the conduit. Where factory bends are not used, conduit bends shall be made without crimping or flattening, using the longest radius practicable.

702.11.8 Trenching

Trenches shall run in straight lines between pull boxes and bases. The location of the conduit shall be as shown on the plans, except that where physical obstructions dictate, the location shall be determined by the Engineer. Conduit shall be installed to a depth of at least thirty inches (30") below finish grade. This requirement may be waived by the Engineer where physical conditions or obstructions warrant.

Trenches shall be backfilled with material free of rock and compacted in lifts by hand tamping or with mechanical tampers to the density noted on the plans. If a density is not specified on the plans, trench backfill shall be compacted until, in the Engineer's opinion, no significant future settlement will occur.

Compaction requirements shall meet City of Wichita Specifications Section 302.3 for "Compacting". Completed trenches which settle and become unsightly, or cause issues as determined by the Engineer shall be fixed and reseeded to the satisfaction of the Engineer at no additional cost.

702.11.9 Conduit in Bases / Boxes

Conduit set in bases shall extend two to three inches (2" to 3") vertically from the top of the base. A plastic or metal conduit bushing shall be installed on the end of all conduit terminating within a base. Conduit shall enter through the sides of a pull box and shall leave the major portion of the box clear. Conduit entering concrete service and junction boxes shall extend 4-8" inside of service or junction box as measured along the longitudinal axis of the conduit. Conduit entering service boxes shall be at least six inches (6") above the crushed rock bottom of the service hole. Conduit should be sloped to drain as directed by the Engineer. At all outlets, conduits shall enter from the direction of the run.

702.11.10 Cleaning

Existing underground conduit to be incorporated into a new system shall be cleaned with a conduit piston mandrel and blown out with compressor air.

702.12 SERVICE, PULL, AND JUNCTION BOXES

Box installations shall be in accordance with the plans, standard sheets, and as noted below. The location of boxes may be adjusted during installation to clear obstructions and facilitate wiring as approved by the Engineer. The quantity of boxes as shown in the Plans may not be reduced. Additional boxes may be provided at the Contractor's expense. Boxes shall not be located in sidewalk ramps. Boxes should be located outside of sidewalk areas when possible and provide positive drainage, preventing a low area that holds water. If located within sidewalk, the top of box shall meet ADA requirements and not exceed a cross-slope of 2%. All boxes shall be free of trash, wire scraps, etc. Cast-in-place or approved precast boxes are permitted.

702.13 GPS LOCATIONS

The Contractor shall provide the City an electronic list of GPS readings (Excel Format) for all installed devices, pull boxes, service boxes, cabinets, power meters, conduit, and transformers. The GPS readings shall match the City of Wichita's current Geographic Information System (GIS) with 'sub-meter' accuracy. The project survey shall be based on NAD83, Kansas State Plane Coordinate System, South Zone, US Survey Feet definition. The vertical datum shall be NAVD88. GPS and three tie-point measurements shall be obtained for each buried electrical pull box prior to placing backfill material. Conduits which are not placed in a straight line, shall be located as needed to establish its exact location and depth with a maximum distance of 50 feet between GPS locations. Any conduits over 50 feet in length must have centerline coordinates.

702.14 BEDDING

A minimum 8-inch thick layer of $\frac{3}{4}$ inch clean, drainable aggregate shall be provided under all service boxes and signal cabinet pads. Aggregate should be placed prior to installing structure. Aggregate will be visually accepted by the Engineer.

702.15 CONDUIT ENTRANCES

The area around the conduit entrance in-ground boxes shall be filled with a mortar grout or a silicone sealant.

702.16 CABLE HOOKS

Cable hooks shall be installed in service boxes as detailed in the Plans.

702.17 BRIDGE MOUNTED

Junction boxes mounted to bridges shall be mounted with wedge anchor bolts of sufficient size and strength to safely secure the box to the structure. The surface of the junction box which comes in contact with concrete shall be covered with aluminum colored butyl rubber sealant (caulking compound).

702.18 CONCRETE FOUNDATIONS FOR POLES AND CONTROLLER CABINET

Concrete foundations for poles, pedestals and cabinets shall be reinforced concrete and as shown in the detail sheets.

702.18.1 Installation

During installation of the concrete for the foundation, the Contractor shall make certain the anchor bolts are in proper orientation, elevation, and verticality. This may be accomplished by using positioning plates and/or tying or wire tying the anchor bolt assembly to the reinforcing steel cage. "Stabbing" or welding of anchor bolts will not be permitted.

It may be necessary to use a concrete form/sonotube for the signal and pedestrian pole bases where previous excavation may have occurred, including for water line or utility work, or sandy soils. It is expected that the signal and pedestrian poles' locations will not be changed, and it is up to the Contractor to account for concrete forms within their bid if they are needed for possible unstable soil conditions.

Steel traffic signal foundations shall be constructed in two (2) pours. The initial concrete placement shall end six inches (6") below finished grade. A six inch (6") thick, thirty-six inch (36") square concrete

cap shall be poured when the pole has been erected, plumbed, and approved by the Engineer. **Under no circumstance shall the pole bolt-flange be recessed in concrete.** The bottom of the pole flange and top of the foundation shall be slightly (1/4" to 1/2") higher than the adjacent curb and gutter. The concrete cap shall be level with the adjacent sidewalk, or approximately 2 - 4 inches above finished grade if no sidewalk is present.

The work apron on the controller pad shall be level with the adjacent sidewalk or approximately one (1) inch above finished grade if no sidewalk is present. If sod is shown to be placed after signal construction, the concrete cap and/or controller pad shall be adjusted an additional four (4) inches higher than finish grade.

Aluminum pedestal bases shall be constructed in one pour as detailed on the plans.

702.18.2 Anchor Bolts

Anchor bolts shall be of the size and design recommended by the manufacturer of the particular pole to be installed. They shall extend uniformly above the finish grade of the concrete base a height equal to the manufacturer's recommendations.

702.18.2.1 ANCHOR BOLT ASSEMBLY. The Contractor shall provide an anchor bolt assembly which may be wire tied to the rebar cage and the resulting unit inserted in the form for the concrete base. The unit shall be designed and constructed such that, after insertion in the form, it can be checked for proper orientation, elevation, and verticality. "Stabbing" or welding of anchor bolts or ground rods will not be permitted.

702.18.2.2 THREADS. The anchor bolt threads shall be protected from concrete fouling when the concrete is poured and extend uniformly above the finish grade of the concrete base to a height equal to the manufacturer's recommendations or a minimum of 3 threads exposed when secured. Under no circumstance shall the bolt-flange of the pole be recessed in concrete.

702.18.2.3 ANTI-SEIZE. Apply an approved anti-seize compound to all threads following the manufacturer's recommendations.

702.19 TRAFFIC SIGNAL POLES AND PEDESTALS

702.19.1 Traffic Signal Poles

The traffic signal vertical poles shall be plumbed after the mast arm and other loads have been applied. Adjustments shall be made using the leveling nuts on the anchor bolts. The final distance between the top of the concrete foundation and the bottom of the leveling nuts shall not exceed one (1) inch and the space between the pole base plate and top of foundation shall not exceed the diameter of the anchor bolt. The nuts shall be thoroughly tightened to the manufacturer's requirements using manufacturer supplied DTI(s) and covered with the nut covers provided with the poles. The Contractor shall install all required components provided by the manufacturer.

702.19.1.1 MOUNTING. The mast arm and luminaire arm(s) (on combination poles) shall be attached as detailed in standard sheets and required by manufacturer. The traffic signal poles shall be back raked according to the manufacturer's recommendation to allow for deflection, such that the pole will be plumb when loaded.

Mast arm extensions allowed on 54.0' or longer lengths only. When used, thru bolts at extension slip joint to be placed from the top side, not the bottom side of the extension.

702.19.1.2 OTHER ATTACHMENTS. All other attachments to the poles and mast arms shall be located in the field, and all wire entrances into the pole or mast arm shall be drilled or punched in the field, and all drilled or punched surfaces shall be carefully reamed to remove any sharp edges or burs before application of a field coat of organic zinc rich paint as described in the latest edition of the American Society for Testing and Materials A123 "Specifications for Zinc (Hot Dip

Galvanized) Coatings on Iron and Steel Products". The one (1) inch rubber grommets supplied with the poles shall be installed at all outlets for signal wiring before the wires are installed. All field work shall be completed to manufacturer recommendations.

702.19.1.3 PLUMBING. Once all loads have been applied and the vertical pole has been plumbed, the Contractor shall fill the opening between the cap and pole base with a non-shrink grout.

702.19.1.4 END CAPS. The end caps provided with the poles shall be securely installed on the end of the arms and the top of the pole prior to acceptance of the signals. Do not seal end caps but allow for draining.

702.19.1.5 HOLES. Rubber grommets shall be installed for wire entrance holes at each penetration location. Holes may be field drilled as per manufacture size and procedures. The minimum size hole should be 7/8" minimum diameter. Holes for wiring penetrations on all poles, mast arms, and pedestals will have a minimum size of 7/8" and must be deburred to prevent damage. Spare/empty holes shall be filled with trade-size smooth-face conduit closure(s) or as directed by City Traffic Signal Maintenance.

702.19.1.6 INCIDENTALS. In the event the pole or mast arm finish is damaged, the Contractor shall use the base primer and finish coat materials furnished by the manufacturer and included with the structure. No other products will be approved unless approved by the Engineer.

In the event signal structure modifications are required, the Contractor shall provide the Engineer with written procedures and approved means and methods from the manufacturer. Modifications shall not affect the structural integrity or warranty of the structure. Any changes shall be approved by the Engineer in writing prior to acceptance. The City may reject modifications and require replacement at no additional cost, including labor and material.

702.19.2 Pedestals & Pushbutton Stations

The cast aluminum pedestal bases shall be bolted to the concrete foundation and tightened to the manufacturer's recommendations.

702.19.2.1 OTHER ATTACHEMENTS. All attachments to the pedestal shall be located in the field and all wire entrances into the pedestal shaft shall be drilled or punched in the field. All drilled or punched surfaces shall be carefully reamed to remove any sharp edges or burs. Plastic or rubber bushings shall be installed at each opening before the wires are installed. All field work shall be completed to manufacturer's recommended practices.

702.19.2.2 POST CAPS. The post cap and hand hole cover provided with the pedestal shall be securely installed prior to acceptance of the signals. Do not seal post caps.

702.19.2.3 BASE COLLAR ASSEMBLY. Pedestals shall include pole and base collar assembly.

702.19.2.4 HOLES. See [Section 702.19.1.5](#) of these specifications.

702.20 TRAFFIC SIGNAL HEAD INSTALLATION

Signal heads shall be installed as close to signal turn-on as practicable. All signal heads shall be mounted and directed away from traffic or be completely covered until signal turn-on. Signal heads shall not be installed over 10 days prior to the signal turn-on, unless otherwise approved by the Engineer.

702.20.1 Viewing

All heads shall be plumbed as viewed from the direction in which they face. The Engineer shall direct the final positioning of the signal heads for optimum visibility. Heads shall be centered in the appropriate lane or as shown on the plans.

702.20.2 Mast Arm Mounting

Mast arm signal head assemblies shall be rigidly mounted by approved brackets. The brackets shall be secured to the mast arm according to the manufacturer's recommendations. Construction shall be such that all conductors are concealed within the assembly.

702.20.2.1 SIGNAL HEADS. All mast-arm signal heads shall be attached to the mast arm at the time of mast arm installation to minimize the effects of vibration. Special care must be taken before drilling the arm for attaching the signal heads so that the signal heads will be in proper orientation over the intended traffic lanes.

702.20.2.2 MOUNTING HEIGHT. Mast arm mounted signal heads shall be installed at a height of 17 feet (minimum) to 19 feet (maximum) from the crown of the roadway to the bottom of the lowest backplate.

702.20.2.3 BACKPLATES. Backplates shall be retroreflective and louver openings shall be positioned to prevent sunlight infiltration through backplate. See Spec [703.4.3](#) for additional details.

702.20.3 Side-of-Pole Mounting

Side-of-pole signal heads shall be supported by approved side-of-pole brackets. All members shall be plumb, level, symmetrically arranged, and securely assembled. Mounting brackets shall be attached to the pole with heavy-duty stainless-steel banding and buckles. Construction shall be such that all conductors are concealed within the assembly.

702.20.3.1 Side-of-pole traffic signal heads shall be installed at a minimum height of 10 feet from the base of pole to the bottom of signal head. Pedestrian signal heads shall be mounted at a minimum of seven (7) feet from the base of pole to the bottom of the signal head.

702.20.3.2 Type II side-of-pole pedestrian signal bracket to be mounted on back side of pole 135° clockwise from mast arm.

702.21 WIRE AND CABLE INSTALLATION

Wire and cable shall be installed per City of Wichita Standard Specifications and in accordance with the wiring diagram in the Plans. Wiring shall conform to the appropriate articles of the National Electric Code (NEC) or subsequent revisions. The conductors from the terminal block in the controller to the signal base shall be a continuous run. No splices of cable will be permitted in conduit or outside of junction boxes, service boxes, or pole bases unless otherwise specified in the supplemental specifications, special provisions, or on the plans for an overhead wiring system. Splices, if required, shall be made above ground in the pole or pedestal bases.

When conductors and cables are pulled into the conduit, all ends shall be taped to exclude moisture, and shall be so kept until the splices are made or terminal appliances attached. Ends of spare conductors shall remain taped. Wire used for future connections shall be appropriately labeled at both ends.

702.21.1 Wire

All wiring shall be of material and type shown in [Section 703.11](#) of these specifications.

702.21.2 Pulling Wires and Cable through Conduit

When pulling conductors through conduits, a pulling sock or other similar device shall be used to equalize pulling strain on the conductors. Powdered soapstone, talc, or other lubricant specifically designed for this purpose may be used. Lubricant not approved for pulling, such as dish soap, may not be used. Using lubricants not approved for pulling may cause the wire to be replaced at the Contractor's expense.

702.21.3 Excess Cable/Slack

A minimum of 6 feet of slack or excess multiconductor cable, detector lead-in cable, loop detector wire, and lighting distribution wire shall be left in each service box. The excess cable in service boxes shall

be neatly coiled and placed on the cable hooks. The excess cable in boxes without cable hooks shall be neatly coiled and placed in the bottom of the box. At least 3 feet of excess multiconductor cable shall be left in each pole base to allow for splice connection.

Excess cable in boxes to be uniformly bundled and secured with a conduit clamp of adequate size attached to side of box with 1/4" threaded stud bolt.

The maximum allowed length of Ethernet / CAT6 cable is 328 feet. Effort should be made to reduce the overall length of the cable. If the maximum length is not being approached, a length of 5 feet of slack should be made at each service box and at the signal controller if available.

702.21.4 Multiconductor Cable in Pedestal Bases

Multiconductor cable runs to pedestal bases shall be spliced in the pedestal base to the multiconductor cables running up the pedestal shaft to the signal heads and/or pushbuttons. Each conductor shall be clearly labeled as to its function with a permanent label, and the splices shall be carefully waterproofed as described in [Section 702.21.11](#). The wires shall be arranged in the base to prevent the splices from coming into contact with the sides of the base or top of the foundation. Any unused conductors shall be taped.

702.21.5 Termination of Field Wire in Signal Cabinet

The Contractor shall clearly identify each field wire coming into the cabinet as to its function with a permanent label and shall connect all field wires to their respective terminals within the cabinet per the wiring diagram furnished with the cabinet.

702.21.6 Pole Wiring

Each signal head shall have a separate run of multi-conductor cable from the pole base to the terminal block in the signal head. A separate seven (7) conductor cable shall run to each three-section signal head; a separate seven (7) conductor cable shall run to each four- or five-section signal head; a seven (7) conductor cable shall run to each pedestrian signal; a two (2) conductor cable shall run to each pedestrian push-button or wiring as recommended by the manufacturer. The ends of any unused conductors shall be taped. Wire used for future connections shall be appropriately labeled at both ends.

The Contractor shall furnish and install all loop wire, shielded loop lead-in wire, power supply cable, detection cable, and traffic signal cable for the complete operation of the traffic signal.

702.21.6.1 PEDESTRIAN MOVEMENT. One seven (7) conductor cable shall be run from the controller to each signal pole pedestrian head. The following color codes shall be used at standard signals, if non-standard phasing is being used, get further direction with city maintenance:

- White - Common
- Red - Don't Walk
- Green - Walk
- Orange - Push Button (AC+)
- White w/Black - Spare
- Blue - Spare
- Black - Push Button (AC-)

702.21.6.2 THREE-SECTION HEAD. One seven (7) conductor cable shall be run from the pole base to each 3-section signal head. The following color codes shall be used:

- White - Common
- Red - Red Ball
- Green - Green Ball
- Orange - Yellow Ball
- White w/Black - Spare
- Blue - Spare

- Black - Spare

702.21.6.3 FOUR OR FIVE SECTION SIGNAL HEAD. One seven (7) conductor cable per conflicting movement shall be run from the controller to each signal pole. The following color codes shall be used:

- White - Common
- Red - Red Ball
- Green - Green Ball
- Orange - Yellow Ball
- Blue - Green Arrow
- Black - Yellow Arrow
- White w/Black - Street Name Sign (where applicable)

702.21.6.5 All cable runs shall be identified in the signal cabinet.

702.21.6.6 HOLES. See [Section 702.19.1.5](#) of these specifications.

702.21.7 Cabinet Wiring

The following is the standard City of Wichita specifications for wiring and labeling cables in a pad mounted cabinet and shall be closely followed. Any deviation from these specifications must be approved by the Engineer or their representative:

- A. All cables shall have adequate excess cable at the termination ends so there is no tension on the conductors.
 - i. Traffic signal cables shall be five (5) feet in length and outer cover stripped back three (3) feet.
 - ii. Pedestrian signal cables shall be the same as the signal cables except the push button conductors shall be seven (7) feet in length to reach the proper termination point without the use of a butt splice.
 - iii. Detector feeder cable shall be eight (8) feet in length and stripped back eight (8) inches.
- B. The cables shall be formed in such a manner so that any access panels can be fully opened without interference.
- C. There shall not be any use of tape on the stripped-out conductors.
- D. Nylon-cable ties shall not be used on any field cables except those used for identification.
- E. The drain wire of each detector feeder shall be covered with a tube type covering (i.e., shrink tube) not more than three (3) times the diameter of the wire.
- F. All cable fillers shall be removed from stripped back cable.
- G. Each conductor shall be separately terminated with a non-locking, insulated block fork terminal of the appropriate size.
- H. All conduits entering the cabinet base shall be closed with an approved duct seal.
- I. All excess cable shall be neatly formed in the bottom of the cabinet.
- J. All cables terminating at the input files shall be run in the provided pan ducts.
- K. Wire penetrating the cabinet wall shall be protected with a chase nipple and plastic bushing.

702.21.8 Cabinet Cable Identification

All cables shall be permanently and legibly identified by the use of Nylon identification Cable Ties. Traffic signal and pedestrian signal cables shall have a marking pad size of 1/2 inch x 7/8 inches (i.e., TY-RAP #TY546M). Detector feeders shall have a marking pad size of 1 inch x 5/16 inches (i.e., TYP-RAP #TY551M). The legends shall be made with a permanent type marking pen or label per [Section 703.13](#).

702.21.8.1 TRAFFIC SIGNAL AND PEDESTRIAN SIGNAL CABLES. The following legends shall be used for traffic signal and pedestrian signal cables:

- "Phase 1 & 6 Sigs" = Traffic signal cable to NW corner
- "Phase 4 & 7 Sigs" = Traffic signal cable to NE corner
- "Phase 3 & 8 Sigs" = Traffic signal cable to SW corner
- "Phase 2 & 5 Sigs." = Traffic signal cable to SE corner

A separate seven (7) conductor cable signal cable shall be used for each pedestrian phase.

- Pedestrian signal cables to NW corner
 - "Ø 6NW Peds"
 - "Ø 8NW Peds"
- Pedestrian signal cables to NE corner
 - "Ø 4NE Peds"
 - "Ø 6NE Peds"
- Pedestrian signal cable to SW corner
 - "Ø 2SW Peds"
 - "Ø 8SW Peds"
- Pedestrian signal cable to SE corner
 - "Ø 2SE Peds"
 - "Ø 4SE Peds"

702.21.8.2 DETECTOR FEEDS. The following legends shall be used for detector feeders:

- "WBLT" = Phase 1 Westbound Left Turn Loop
- "EB FAR" = Phase 2 Eastbound Far Advance Loop
- "EB MID" = Phase 2 Eastbound Middle Advance Loop
- "EB CLOSE" = Phase 2 Eastbound Close Loop
- "EB RT. LN." = Phase 2 Eastbound Right Lane Loop (If Applicable)
- "EB LT. LN." = Phase 2 Eastbound Left Lane Loop (If Applicable)
- "SBLT" = Phase 3 Southbound Left Turn Loop
- "NB FAR" = Phase 4 Northbound Far Advance Loop
- "NB MID" = Phase 4 Northbound Middle Advance Loop
- "NB CLOSE" = Phase 4 Northbound Close Loop
- "NB RT. LN." = Phase 4 Northbound Right Lane Loop (If Applicable)
- "NB LT. LN." = Phase 4 Northbound Left Lane Loop (If Applicable)
- "EBLT" = Phase 5 Eastbound Left Turn
- "WB FAR" = Phase 6 Westbound Far Advance Loop
- "WB MID" = Phase 6 Westbound Middle Advance Loop
- "WB CLOSE" = Phase 6 Westbound Close Loop
- "WB RT. LN." = Phase 6 Westbound Right Lane Loop (If Applicable)
- "WB LT. LN." = Phase 6 Westbound Left Lane Loop (If Applicable)
- "NBLT" = Phase 7 Northbound Left Turn Loop
- "SB FAR" = Phase 8 Southbound Far Advance Loop
- "SB MID" = Phase 8 Southbound Middle Advance Loop
- "SB CLOSE" = Phase 8 Southbound Close Loop
- "SB RT. LN." = Phase 8 Southbound Right Lane Loop (If Applicable)
- "SB LT. LN." = Phase 8 Southbound Left Lane Loop (If Applicable)

702.21.8.3 SIGNAL AND PEDESTRIAN FIELD WIRING TERMINATION. The traffic signal and pedestrian signal field wires shall terminate at the following locations in all cabinets:

- Phase 1 - RED 125, YELLOW 126, GREEN 127
- Phase 2 - RED 128, YELLOW 129, GREEN 130
- Phase 2 Peds - DW 113, WALK 115
- Phase 3 - RED 116, YELLOW 117, GREEN 118
- Phase 4 - RED 101, YELLOW 102, GREEN 103

- Phase 4 Peds - DW 104, WALK 106
- Phase 5 - RED 131, YELLOW 132, GREEN 133
- Phase 6 - RED 134, YELLOW 135, GREEN 136
- Phase 6 Peds - DW 119, WALK 121
- Phase 7 - RED 122, YELLOW 123, GREEN 124
- Phase 8 - RED 107, YELLOW 108, GREEN 109
- Phase 8 Peds - DW 110, WALK 112

702.21.8.4 DETECTOR FEEDERS FIELD WIRING TERMINATION. The detector feeders and the pedestrian pushbutton field wires shall terminate at the following locations in all 332L cabinets:

- WBLT - I-1-DE
- EB FAR ADV - I-2-DE
- EB MID ADV - I-2-JK
- EB CLOSE - I-3-DE
- SBLT - I-5-DE
- NB FAR - I-6-DE
- NB MID - I-6-JK
- NB CLOSE - I-7-DE
- EBLT - J-1-DE
- WB FAR - J-2-DE
- WB MID - J-2-JK
- WB CLOSE - J-3-DE
- NBLT - J-5-DE
- SB FAR - J-6-DE
- SB MID - J-6-JK
- SB CLOSE - J-7-DE

702.21.8.5 DRAIN WIRE TERMINATION (332L CABINET). All drain wires to terminate at terminal L of the corresponding slot for pedestrian push buttons if not specified by manufacturer.

- EB PEDS. - I-12-D
- NB PEDS. - I-12-J
- WB PEDS. - I-13-D
- SB PEDS. - I-13-J

702.21.8.6 OTHER. If any additional loop or field wire terminations are necessary, their location will be determined by the Engineer or their representative.

702.21.9 Mast Arm and Pole Base Cable Identification

The following is the specification for identifying all cables used in the complete operation of the traffic signals which are located in mast arms and pole bases. The through traffic and pedestrian signal cables shall be legibly identified with the use of Nylon Identification Cable Ties. The marking pad size shall be 1/2-inch x 7/8 inches (i.e., TY-RAP #TY546M). The legend shall be made with a permanent type marking pen or label per [Section 703.13](#).

The pushbutton cable shall be legibly identified with the use of Nylon identification Cable Ties. The marking pad size shall be 1 inch x 5/16 inches (i.e., TY-RAP #TY551M). The legends shall be made with a permanent type marking pen.

702.21.9.1 MAST ARM SIGNAL CABLES

- "Left Turn Sig." - Left Turn Signal
- "Far Left Sig." - Farthest Through Traffic Signal from Pole
- "Center Sig." - Next Farthest Through Traffic Signal from Pole (If Applicable)
- "Far Right Sig." - Closest Thru Traffic Signal to Pole
- "SOP Sig." - Side of Pole Through Traffic Signal

702.21.9.2 POLE MOUNTED PEDESTRIAN SIGNALS AND PUSHBUTTONS.

- "Ped. Sig." - Pedestrian Signal
- Label pedestrian signal cable for appropriate phase (Ph.X P.B.)

702.21.10 Messenger Cable

Where shown in the plans, the messenger cable shall support all overhead communications and detector lead-in cable. The messenger cable shall include devices such as rings or spiral slashing used to attach the cable and shall run from structure to structure without splicing. Prior to erecting messenger cable, the Contractor shall determine the length of the strand required to span the distance between the poles indicated on the drawings, allowing a sufficient additional length of span wire to compensate for sag.

No messenger cables shall be erected which would lie on, or are liable to run on, a utility company wire or cable, tree limb, etc. If a messenger cable is erected within 12 inches of any other cable, wire, or structure, it shall be protected with plastic wire guards. The height of the messenger cable on the pole shall conform to requirements of the serving utility and the National Electrical Code, and the National Electric Safety Code.

702.21.11 Splices

Conductors shall be joined by twisting the conductors. Conductor insulation shall be penciled and trimmed to conical shape before applying splice insulation. Splice insulation shall comprise three (3) layers of thermoplastic or neoprene insulation electrical tape bearing the label of the Underwriters Laboratories (UL), Inc., applied to a thickness equal to and well lapped over the original insulation, except that on high voltage splices two layers of rubber tape conforming to the requirements at A.S.T.M. designation: D 119 shall be applied over the conductor before placing the thermoplastic tape. The splice shall then be well covered with two layers of friction or other approved tape.

When terminating ends of cable at all terminal blocks, an approved #14 insulated spade terminal shall be properly crimped on end of each conductor to provide a secure connection. Locking spade terminals shall not be used.

702.22 GROUNDING

The traffic signal system shall be grounded per the plan standards, as specified herein, and in [Section 703.10](#). All traffic signal poles, pedestals, controller cabinets, and service circuit breakers shall be grounded by a No. 6 AWG (minimum or as shown on plans) ground wire bolted to the inside of these devices with a 3/4-inch internal ground lug. All ground wires shall be attached by means of a master ground bus, ground clamp, and ground rod to form a continuous ground circuit. Ensure ground wires from all equipment have the shortest lead length possible with direct connection to the ground bus bar. Avoid cable loops and bends for all ground bonds and wires. Ground rods shall be installed as detailed in the Plans.

702.22.1 Detector Wire

The detector lead-in shielding and drain wire shall be electrically floating (not attached to earth ground) at the pullbox. The recommendations of the loop detector manufacturer should be followed concerning whether or not the cabinet end is grounded.

702.22.2 Ground Rods

702.22.2.1 TWENTY FOOT (20') GROUND RODS. A 3/4"x 20' copper clad ground rod shall be installed in each traffic signal mast arm pole base and 342 cabinet as shown on the plans. The top of the ground rod shall be accessible through the pole base hand hole. Two (2) 3/4" x 12' ground rods coupled together with an approved coupler. may be used instead of one (1) 20' rod.

702.22.2.2 TWELVE FOOT (12') GROUND RODS. A 3/4"x 12' copper clad ground rod shall be installed in each service box, service point, Millbank, APS pushbutton station, signal pedestal, 332L cabinet, and 336L cabinet as shown on the plans. The top of the ground rod shall be accessible through the pole base hand hole.

702.22.3 Ground Wire

Install ground wire per plan standards. Ground wire shall be bonded to each ground rod at every pole, pedestal, service box, and controller to form one continuous ground circuit. [See Section 703.10.4](#) for additional details.

702.23 VEHICLE DETECTION SYSTEMS

All Vehicle Detection Systems shall be a complete assembly of all required equipment and components for the detection of vehicles. The bid item shall be "Detection System" bid as a lump sum. Detector timings should be programmed into the traffic signal controller. A separate detection card shall be used for each intersection leg. The detection system includes detector unit, processor, card, and incidental items necessary for the successful operation of the detection system.

702.23.1 Video Detection System (VDS)

Installation of VDS shall be per the Standard Specifications and as noted below. Include items on the materials list for all quantities which are indicated in the Bill of Materials. Install the VDS according to the manufacturer's requirements and the contract documents. The actual quantity of equipment to be furnished is to be installed and made fully functional, as a complete VDS, by the Contractor at the location shown in the Plans. Provide the Engineer with the manufacturer's written requirements.

702.23.1.1 INSTALLATION AND TRAINING (VDS). A factory certified representative from the supplier must be on site during installation, testing, and training of the video and computer equipment. If requested, two days of training shall be provided for the owner's personnel in the operation of the VDS including setup and maintenance. Ensure that the trainers are certified by the equipment manufacturer and meet the certification requirement in [Section 702.2](#) of the Standard Specification. Camera fine tuning and system set-up and programming shall be performed by the supplier with help of the Contractor. One complete electronic manual (.pdf) shall be provided to the Owner. If requested by Engineer or Owner, a hard copy shall be provided.

702.23.1.2 DETECTION ZONE (VDS). The video detection system must provide flexible and reliable detection zone placement anywhere within the combined field of view of the image sensors. Preferred presence detector configurations are lines or boxes placed across lanes of traffic or lines placed in line with lanes of traffic. In addition, detection zones must be capable of implementing logical functions, including delay timing. These logical functions may be excluded if provisions are made to bring each detector separately into the controller and the controller can provide these functions. Logical functions are not to be done with the processor (delay/extend) but shall be in completed within the signal controller timing configuration. A minimum of four (4) outputs are required. Place the detection zones through graphical interface using the video image of the roadway. The detection zones must be capable of being sized, shaped and overlapped to provide optimal road coverage and to retrieve the detector configuration that is currently running in the VDS processor unit. Once a detection configuration is created, the system must provide a graphic display of the new configuration on the field monitor. Detection accuracy must include the presence of any vehicle in the defined detection zone regardless of the lane that the vehicle is occupying.

702.23.2 Radar Detection System (RDS)

Radar detection is an option for advanced and/or presence detection if approved by the Design Engineer. Installation of radar detection shall be per the Standard Specifications and as noted below. Include items on the materials list for all quantities which are indicated in the Bill of Materials. The RDS shall be installed according to the manufacturer's written requirements with the actual quantity of equipment to be furnished, installed and made fully functional, by the Contractor at the location(s) shown in the Plans. If requested, provide the Engineer with the manufacturer's written requirements.

702.23.2.1 INSTALLATION AND TRAINING (RDS). A factory certified representative from the supplier must meet the same specification as Section 702.23.1.1 for radar and video installation and training. Trainers are to be certified and meet the requirement in [Section 702.2](#) of the Standard Specification.

702.23.2.2 DETECTION ZONE (RDS). The radar presence detection zone must meet as a minimum Section 702.23.1.2. Advance radar detection shall provide the necessary adjustments to detect approaching vehicles on high-speed facilities. All radar detection shall include the necessary hardware and software required to communicate with the controller according to these standard specifications and the Plans.

702.23.3 Combination Video / Radar Detection System (Hybrid)

Hybrid detection systems are not to be used unless specifically approved by the City of Wichita Traffic Engineer. Only if approved, the Video / Radar detection is an option for advanced and/or presence detection. Installation of combination detection shall be per the Standard Specifications for the respective device. Include items on the materials list for all quantities which are indicated in the Bill of Materials. The combination device shall be installed according to the manufacturer's written requirements with the actual quantity of equipment to be furnished, installed and made fully functional, by the Contractor at the location shown in the Plans. If requested, provide the Engineer with the manufacturer's written requirements.

702.23.4 Microloop Detection

Microloop detection systems are not to be used unless specifically approved by the City of Wichita Traffic Engineer. Before installing the microloop probe, a magnetic field strength and a magnetic field noise measurement shall be taken at the location of installation shown on the project plans. The readings must fall within the prescribed limits set by the manufacturer or their representative. If measurements as determined by engineer exceed specified limits, appropriate measures shall be taken to bring them within operational limits per manufacturer's specifications. If manufacturers specified limits cannot be met, a standard inductance loop, as determined by Engineer, shall be installed instead of microloop.

Make a saw cut from the curb to the furthest most probe location and remove any water from cut. Bore a 1 1/2" hole 18" below the 1/4" by 3 1/2" deep saw cut at determined probe location(s) for insertion of a 1" PVC conduit. The conduit shall be cut to an 18" length and bottom cap installed (1" plastic "push penny" plug, i.e., T&B #1472).

If when installing two or more probes in a set, and there is excess cable between probes, a hole of sufficient depth shall be bored between the probes and the excess cable be inserted into the hole. Fine dry sand, such as sandblasting sand, or other material approved by the Engineer should fill the holes and conduit to the bottom of the saw cut. Any excess area around the conduit should also be filled.

Before beginning permanent installation, resistance checks shall be made with an ohmmeter. Readings shall be in accordance with manufacturer's expected readings. Also, a reading shall be taken with a megohm meter to ensure that resistance to ground is greater than 100 megohms. These checks shall be made before the permanent splice is made and taken at the cabinet before termination. An approved sealant shall then fill the saw cut.

702.24 SIGNS

Installation of signs shall be in accordance with the plans and detail sheets.

702.24.1 Overhead Street Name Signs

Street name signs shall be installed on mast arms after all other loads are applied to the mast arm. The signs shall be located in accordance with the plan details. Signs shall be mounted so that the legend is plumb and level. Right edge of sign to align with curb. If no curb is present, center sign between the first signal head and the vertical pole. The final location shall be determined by the Engineer.

702.24.2 Regulatory Signs

The R10-Series signs shall be mounted on the mast arm to the right of the left turn signal head using an approved sign mounting bracket as shown in the traffic signal installation details.

702.24.3 Overhead Street Name and Regulatory Sign Installation

Installation of signs on mast arms shall be accomplished with suitable cable mount brackets capable of withstanding 100 miles per hour winds. Signs over 18 inches in height shall be installed using approved sign mounting brackets as shown in the Plans. All bolts inserted through sign faces shall have flat fiber washers installed between the reflective sheeting and bolt heads. Bolt holes in signs shall be drilled in the field.

702.24.4 Pedestrian Pushbutton Signs

Pedestrian pushbutton signs shall be mounted to the traffic signal pole above the appropriate pedestrian pushbutton. Mounting shall be accomplished by field drilling and tapping hole and bolted to post with the fiber washer. Mounting shall be capable of withstanding 100 mile per hour winds. Signs shall be 9"x15" as required per MUTCD.

702.25 PEDESTRIAN PUSHBUTTON INSTALLATION

Pedestrian pushbuttons shall be installed on the poles or pedestals as indicated in the Plans. They shall be installed at a height of 3 feet 6 inches (42 inches) above the sidewalk (or ground if no sidewalk is present). The pushbutton shall be located on the side of pole nearest the pedestrian walkway, and perpendicular to the intended crossing direction. Pushbutton extension brackets may be used as needed and shall match pole color and be of similar material.

Pushbutton Installation shall be in accordance with the plans, detail sheets, and latest edition of the MUTCD (2009 MUTCD Section 4E.08).

702.26 ACCESSIBLE PEDESTRIAN SIGNAL (APS)

If two accessible pedestrian pushbuttons are placed less than 10 feet apart or on the same pole, each accessible pedestrian pushbutton shall be provided with the following features (2009 MUTCD Section 4E.11 through 4E.13).

- A. A pushbutton locator tone,
- B. A tactile arrow,
- C. A speech walk message for the WALKING PERSON (symbolizing WALK) indication, and
- D. A speech pushbutton information message.

If two accessible pedestrian signals are separated by a distance of at least 10 feet, the audible walk indication shall be a percussive tone. Where two accessible pedestrian signals are on one corner are not separated by a distance of at least 10 feet, the audible walk indication shall be a speech walk message.

702.27 TRAFFIC SIGNAL TURN-ON

702.27.1 Flashing Operation

At locations without previous traffic signal control, the new traffic signals shall be flashed 2 to 3 business days prior to full signal system turn-on.

702.27.2 System Turn-On

The signal system turn-on shall not occur on Fridays, weekends, or holidays. Turn-on may occur Monday-Thursday, 9:00 AM to 3:00 PM on the day of the turn-on unless specifically approved otherwise by the Engineer.

702.27.3 Traffic Engineering Notification

The City of Wichita shall be notified at least one week in advance of the expected date of signal turn-on.

702.27.4 Cleaning

Traffic signal cabinet and surrounding area shall be cleaned up of debris, metal shavings, wiring scraps, etc. to the satisfaction of the Engineer.

702.28 TRAFFIC SIGNAL INSPECTION CHECKLIST

The Contractor shall review and submit to the Engineer a completed "City of Wichita Traffic Signal Inspection Checklist" available online at www.wichita.gov. The checklist must be completed prior to City, traffic signal maintenance, or engineering full inspection.

702.29 TEST PERIOD

Following completion of all electrical apparatus hookups and the system turn-on, the signals shall operate satisfactorily for 30 days under normal operation prior to acceptance by the City. During the test period, the signals shall operate trouble-free with no major or minor failures of the controller or its components as determined by the Traffic Engineer. Should any defect develop under normal and proper operating conditions during the testing period and prior to acceptance by the City, this malfunction shall be corrected by and at the expense of the Contractor, including all labor, materials, and associated costs. Minor failures such as lamp failures or loop detector re-tuning will not be the basis for starting a new test period, provided the failures are repaired immediately and the same failures do not recur during the remaining test period. A major malfunction or failure of the controller and its components will result in a new 30-day test period being implemented after the repairs have been made.

If a traffic signal malfunction occurs between successful turn-on and final acceptance and the signal malfunction is due to faulty work by the Contractor, the City Maintenance Division may take corrective action and has the discretion to bill the contractor for all related expenses, including overhead.

702.30 FINAL ACCEPTANCE

Final acceptance by the City is conditional until the Contractor has corrected all defects and punch list items. Final acceptance will be by written notice of Engineer.

702.31 WARRANTY

The warranty period begins once the final acceptance by the City has occurred. Confirmation of the acceptance should be provided in written documentation.

702.32 GUARANTEE

All equipment furnished on a project by the Contractor shall be guaranteed against any imperfections in workmanship and materials. The customary manufacturers' warranties shall be assigned to the Maintaining Agency.

702.33 MANUALS

An electronic format (.pdf) manual shall be provided for each controller and shall include complete nomenclature, wiring diagrams, schematics showing test voltages, functional description of circuits, parts list and cross reference to standard part numbers, appropriate testing procedures, and other pertinent data. Upon request, a minimum of two (2) paper (hard) copy manuals may be provided.

SECTION 703 - MATERIALS

703.1 GENERAL

These specifications cover the general materials and miscellaneous hardware for the installation of a traffic signal to be constructed in accordance with and at locations indicated in the contract, shown in the Plans or designated by the Engineer.

Unless otherwise noted in the plans, all equipment, materials and incidental parts shall be new and of similar manufacturer. All incidental parts which are not shown on the plans or described in these Specifications and which are necessary to complete the traffic signal installation, shall be furnished and installed as though such parts were shown on the plans or described in these Specifications.

The traffic signal shall be complete, and the Contractor shall furnish and install all equipment necessary for the satisfactory operation of the signal system, whether or not specifically mentioned.

703.2 TYPE 2070 TRAFFIC SIGNAL CABINET ASSEMBLY

The Type 2070 traffic signal control systems shall, as a minimum, meet the Caltrans Transportation Electrical Equipment Specifications (TEES), dated March 12, 2009 and Errata 2.

703.2.1 Controller Unit

The traffic signal controller shall be a Model 2070 Advanced Transportation Controller (ATC) unit. The unit shall be interchangeable with standard 170 controllers and support Flashing Yellow Arrow (FYA). Each controller shall be delivered with intersection firmware installed. The firmware shall be approved by traffic signal maintenance prior to implementation. The traffic signal controller may be of the two following options:

703.2.1.1 SIEMENS EAGLE MODEL 2070LX. Controller shall fully comply with ATC5201 v6.24 and TEES 2009 by CalTrans. The Contractor shall provide evidence that controller units, with a make and model identical to those being provided, have been tested and approved in accordance with TEES, by Caltrans, or an approved agent of City of Wichita. A Quality Control Plan shall be submitted within fifteen (15) days from the Notice to Proceed (NTP) as required by the TEES.

703.2.1.2 TRAFFICWARE MODEL 2070C/LX ATC. Controller shall be in full compliance with ATC5201 v6.24 and TEES 2009 by CalTrans. The Contractor shall provide evidence that controller units, with a make and model identical to those being provided, have been tested and approved in accordance with TEES, by Caltrans, or an approved agent of City of Wichita. A Quality Control Plan shall be submitted within fifteen (15) days from the Notice to Proceed (NTP) as required by the TEES.

703.2.1.3 MOUNTING CONFIGURATION. Controller shall not be directly mounted to 19" Electronic Industries Alliance (EIA) rack but shall sit on shelf or brackets to allow for easy removal.

703.2.2 Conflict Monitor

The conflict monitor shall be a 2010 ECL-IP Monitor meeting the requirements outlined in CALTRANS TEES 2009 (Latest Edition) with the following additional monitoring functions: red monitoring; absence of signal on a channel; simultaneous multiple indications on a channel; program card ajar; power interrupt after failure; short or absence of yellow; AC line monitoring; full systems compatibility with Wapiti Microsystems Traffic Systems software.

703.2.3 Load Switch

The load switch shall be easily replaced with the use of a screwdriver and meet the requirements of a Model 200/510 switch pack per Chapter 3 Section 2 of the TEES.

703.2.4 Flasher

The flasher shall meet the requirements of a Model 204/804 flasher per Chapter 3 Section 3 of the TEES.

703.2.5 Flash Transfer Relay

The flash transfer relays shall be heavy duty relays meeting the requirements of the Model 430 per Chapter 6 Section 4 (6.4.6) of the TEES.

703.2.6 Surge Protection

The surge protector shall be a filtering surge protector that absorbs power line noise and switching transients and provides lightning protection. The surge protector must contain indication lights showing the unit is functioning properly or requires replacement. It shall consist of three basic sub circuits: primary clamp, secondary clamp, and the filter. It shall be rated for a peak current of 20,000 amps from an 8 by 20 microsecond wave shape. The clamp voltage shall never exceed 280 Volts during a peak surge. It shall provide a maximum of 10 amps continuous service current at 120 Volts AC and 60 Hertz. It shall have an operating temperature range of -40 to +85 degrees Celsius. The filter shall be designed to absorb power line noises in the range of 10 kilohertz to 20 Megahertz

A hybrid power line surge protection device such as the EDCO SHA-1210 Surge Protector or equal shall be installed in each controller cabinet. The protector shall be installed between the applied line voltage and earth ground. The surge protector shall be capable of reducing the effects of transient voltages applied to the AC line. The protector shall be mounted inside the PDA#2. The Equipment Line Out shall provide filtered power to the controller, 24 VDC power supply, input file and conflict monitor through shielded cable or twisted pair to the unit's AC plus and AC minus inputs.

703.2.6.1 MINIMUM REQUIREMENTS

- A. Maximum AC line voltage: 140 VAC.
- B. Twenty pulses of peak current, each of which will rise in 8 microseconds and fall in 20 microseconds to one-half the peak: 20,000 Amperes.
- C. The protector shall be provided with the following terminals:
 - o Main Line (AC line first stage terminal).
 - o Main Neutral (AC neutral input terminals).
 - o Equipment Line Out (AC line second stage output terminal, 10 Amps.).
 - o Equipment Neutral Out (neutral terminal to protected equipment).
 - o The Main AC Line In and the Equipment Line Out terminals shall be separated by a 200 Microhenry (minimum) inductor rated to handle 10 Amp AC Service.
 - o The first stage clamp shall be between Main Line and Ground terminals.
 - o The second stage clamp shall be between Equipment Line Out and Equipment Neutral.
- D. LED Indication light(s) which show the functionality and visual indication of surge protector status.

703.2.7 DC Isolator

The DC isolator shall meet the requirements of a Model 242 two-channel DC isolator per Chapter 5 Section 4 of the TEES and must have output inverted with jumpers.

703.2.8 AC Isolator

When called for in the Plans, the AC isolator shall meet the requirements of a Model 252 two-channel AC isolator per Chapter 5 of the TEES.

703.2.9 GPS Time Clocks

The GPS time clocks should be provided with all signals and must be compatible with the specified 2070 controller and the City's existing Siemens Eagle 2070L hardware and software.

703.2.9.1 REQUIREMENTS. The GPS shall be configured such that the controller's time is updated automatically on a user-programmable schedule.

703.2.9.2 MOUNTING. The preferred GPS time clock will be able to be plugged into any standard internal 2070 module. Rack mount units are not permitted.

703.2.10 Loop Detector, 2-Channel or 4-Channel

Each detector unit shall be provided with a test switch position to verify loop system integrity. The open loop test position shall indicate a previous fault via the front panel indicator. The memory shall remain intact and can be queried repeatedly. Existing detections shall not be reset, and the memory shall only be reset by removing and reinserting the detector unit.

Each detector unit to have 60 Hertz filter to reduce power line noise.

Each detector unit to provide traffic count capability via serial interface.

703.2.11 Cabinets

The cabinets shall be Model 332L series (pad mounted), Model 342 (pad mounted, double), or 336L series (pole mounted) meeting the requirements of Chapter 6 of the TEES with the following modifications.

703.2.11.1 HARDWARE. The cabinet shall be furnished with anchor bolts, nuts, and washers.

703.2.11.2 FINISH. The cabinet shall be a minimum of 0.125" natural aluminum finish. A black finish may only be used if specifically shown in the plans.

703.2.11.3 LIFT EYES. The cabinet lift eyes shall be removable so they can be turned down after installation of the cabinet.

703.2.11.4 CABINET FILTER. Provide Fiberglas disposable filters instead of metal filters. Filter shall be held in place with an aluminum backplate.

703.2.11.5 LIGHT FIXTURES. Cabinets shall be furnished with LED light fixtures over the front and back doors that are controlled by door-activated switches.

703.2.11.6 CABINET LOCKS. Provide all main cabinet doors with a Corbin #2 lock with a three-point locking mechanism fabricated so it may be actuated by rotating a removable 15 mm hex key. The hex socket and locking cam shall rotate on a 19 mm minimum diameter shaft.

703.2.11.7 SOCKET AND SHAFT. The socket and shaft shall be field-replaceable with common tools. The socket head shall be protected from being rotated with a pipe wrench or similar tool. One aluminum hex wrench shall be provided with each cabinet.

703.2.11.8 TERMINAL BLOCK. Each cabinet shall be furnished with a communications terminal block, conforming to the requirements detailed in the Caltrans Specifications*. Terminal blocks shall include jumpers on neutrals.

703.2.11.9 TBO/COMMUNICATIONS TERMINATION BLOCK. This terminal block will serve as the termination block for the communication conductors, overvoltage protection devices, and the termination points for the C2P harness and conductors. Install over voltage protection ground bus and hardwire to equipment ground bus with #8 AWG wire. Each terminal on output terminal blocks to be marked as per phase function.

703.2.11.10 INPUT FILE CIRCUIT BOARD. Must be accessible without removing or lowering panel.

703.2.11.11 DIN RAIL. All cabinets shall be equipped with a 19" EIA rack.

703.2.11.12 POWER STRIP. Supply all cabinets with a rack mounted power strip receptacle. Include a minimum of 8 receptacles on unit. Use UL 1449 rated for 330V surge suppression. Provide power strip to protect from over voltages up to 40,000 amps per phase. The power strip must be plugged into one of the cabinet outlets. Do not plug the power strip into the GFCI receptacles.

703.2.12 Pad Mounted Cabinets (332L & 342)

The Model 332L and Model 342 cabinets shall be furnished with the power distribution assembly #2 instead of the power supply and power distribution #1 assemblies. The cabinets shall be supplied with the circuit breaker option per Chapter 6 Section 4 of the TEES. Provide 44-pin input file.

The cabinet assembly shall be provided with a Power Distribution Assembly (PDA) #2 with modifications and the circuit option (Section 6.4.3.9 of the Caltrans Specifications*).

All #8 conductors from service panel (TBS) and SSR contactor to signal bus and main equipment bus shall be 133 strand #29 AWG electronic hook-up wire.

703.2.12.1 ADDITIONAL OUTPUT FILE #1 REQUIREMENTS. The output file #1 supplied the cabinet shall be modified to provide compatibility with the red monitoring features of the conflict monitor.

703.2.12.2 332L CABINET SIZE. The cabinet shall be pad mounted type with overall dimensions of approximately 67"H x 24"W x 30"D.

703.2.12.2 342 CABINET SIZE. The cabinet shall be pad mounted type with overall dimensions of approximately 67"H x 45"W x 26"D.

703.2.13 Pole Mounted Cabinet (336L)

The Model 336L cabinets shall be furnished with a continuously welded or bolted solid one-piece plate bottom of the same material as the rest of the cabinet, and all the hardware necessary to permit mounting to a 12-inch outside diameter pole.

The cabinet shall be a weatherproof, outdoor, pole-mounted or pedestal-mounted type with overall dimensions not to exceed 46"H x 24"W x 20"D. The cabinet will use all the standard plug-in modules that are used by the Type 336 Caltrans cabinets.

The bottom of all 336L cabinets shall be solid plate and be reinforced with a 20" x 22" 0.375 aluminum base plate continuously welded to the inside bottom of the cabinet.

Cabinets shall be attached to the pole using two aluminum mounting brackets, mounted top and bottom, for each cabinet. The brackets shall be secured to the cabinets using appropriate stainless steel mounting bolts and washers. The brackets shall be secured to the pole by appropriate banding buckles and couplings.

Door opening flange around the door opening shall be 0.75 inches wide.

Steel rails shall be provided in lieu of the rack cage for mounting of the controller and cabinet assemblies. The rail assembly shall consist of 4 EIA threaded rails bolted to the two sides at the front and rear of the cabinet. The rails shall be threaded in the same manner and pattern as the Model 332L cabinet cage. The rails shall be plated as specified in Caltrans Specifications*, Section 1.2.8.3.2. Provide 22-pin serial input file.

703.2.14 Battery Backup System (BBS) / Uninterrupted Power System (UPS)

The BBS/UPS shall be compatible with NEMA, or Caltrans 332 / 336 Series Model 2070 Controller cabinets. The BBS/UPS shall provide reliable power to the traffic signal (vehicle and pedestrian) in the event of a power interruption or power failure. Full operational working time shall be four (4) hours of

full run-time operation for an "LED-only" intersection. Once the battery reaches 40% of remaining life, the traffic signals will switch to flash mode for a minimum of two (2) hours. The BBS/UPS shall include, but not be limited to the following: inverter/charger, power transfer relay, batteries, a separate manually operated non-electronic bypass switch and all necessary hardware, installation wiring kit, and interconnect wiring. The BBS/UPS shall be capable of providing power for full run-time operation for an intersection (with green, yellow, and red lights), including detection and flashing red light mode operation for an intersection not exceeding the full load capacity of the BBS/UPS. The BBS/UPS shall incorporate a Double Conversion (On-Line type) or Line Interactive (Buck/Boost) modes with a minimum input range of 90-150 VAC with built-in surge protector, noise filter, and voltage regulator. The BBS/UPS shall meet NEMA, TEES, NEC standards.

703.2.14.1 BBS / UPS SYSTEM. The maximum transfer time from loss of power to switch over to BBS / UPS shall be 150 milliseconds. The BBS/UPS shall provide as a minimum 2-sets of normally open (NO) and normally closed (NC) single-pole double-throw (SPDT) relay contact closures, available on a panel-mounted terminal block, rated at a minimum 120 VAC +/- 3% at 60 Hz +/- 0.1% to the cabinet. The first set of NO and NC contact closures shall be energized whenever the unit switches to battery power (On Batt) and the second set of NO and NC contact closures shall be energized whenever the battery approaches approximately 40% of remaining useful capacity (Low Batt). Operating temperature for both the inverted/power transfer and manual bypass switch shall be -37°C to +74°C.

The provided system inverted/charger, power transfer relay and manually operated bypass switch shall be placed in the traffic signal cabinet.

703.2.14.2 BATTERY CABINET. The batteries shall be housed within an aluminum external battery side enclosure with louvered front vents and Corbin #2 lock. The enclosure finish shall match the traffic signal cabinet. The external battery enclosure shall come with all bolts, conduits and bushings, gaskets, shelves and hardware needed for mounting. The cabinet may only house batteries and battery charge management unit. Other BBS devices, including the controller, shall be located inside the traffic signal cabinet. The cabinet shall be side mounted to the traffic signal cabinet (piggy-back). The battery cabinet shall be ventilated per TEES Chapter 7 Section 2 - Housings. Wire penetrating the wall shall be protected with a chase nipple and plastic bushing.

703.2.14.3 BATTERIES. Individual batteries shall be 12 Volt, 100 amp-hour maximum, and shall be easily replaced and commercially available off the shelf. Batteries shall be deep cycle, sealed prismatic lead-calcium based Gel or Absorbed Glass Valve Regulated Lead Acid (AGM/VRLA). Batteries used for BBS shall consist of 4 to 8 batteries with a cumulative minimum rated capacity of 400 amp-hours. Batteries shall be certified by the manufacturer to operate over a temperature range of -25C to +74C.

703.2.15 Police Compartment Switches

The panel behind the police door shall contain 2 switches to accomplish the following functions: (1) change from normal position to flashing, and vice versa, and (2) interrupt power to the signal heads.

703.3 DETECTION SYSTEM

All detection will interface through the Caltrans input file(s) with individual module(s) for each direction/intersection leg/signal phase. Left turn phases may be combined.

703.3.1 Video Detection System (VDS)

Shall be capable of providing presence only vehicle detection at the intersection(s) using tripline or stop bar detection zones. All material furnished and installed under the VDS bid item shall be new and corrosion resistant. The VDS shall be expandable without removing or replacing existing units. VDS shall provide medium resolution and real time video detection image sensors (within 0.1 second of vehicle arrival).

703.3.1.1 VDS CAMERA. Shall be furnished by the video detection processor (VDP) supplier and shall be qualified by the supplier to ensure proper system operation. The camera shall produce a useable video image of the vehicles under all roadway lighting conditions, regardless of time of day but not less than the range 1.0 lux to 10,000 lux. Camera shall be digital signal processor (DSP) based and shall use a 0.25- or 0.33-inch view hole CCD sensing element with an infrared filter. Output color video with resolution of not less than 400 TV lines shall be provided. The CCD imager shall have a minimum effective area of 768(h) x 494(v) pixels conforming to NTSC/RS 170. The projected area shall be 2.5 square feet or less with a maximum weight of 30 lbs. The camera shall include an electronic shutter control based upon average scene luminance and shall be equipped with an auto-iris control lens that operates in tandem with the electronic shutter. The camera shall include a variable focal length lens with variable focus that can be adjusted, without opening the camera housing, to suit the site geometry.

703.3.1.2 CAMERA HOUSING. The camera housing shall be waterproof and dust-tight meeting NEMA 4 and IP 66 or above, standards. Provide a camera housing with a sun shield to minimize solar heating. The housing shall maintain an ambient temperature range of -30°F to +140°F while exposed to precipitation as well as direct sunlight. The camera housing shall have rotation of the camera horizon in the field during installation. Housing shall have a rear connection for power and video signal cables fabricated at the factory. A heater at the front of the enclosure to prevent the formation of ice and condensation shall be provided. When operating in the camera housing with power and video signal cables connected, the image sensor must comply with FCC Class B requirements for electromagnetic interference emissions.

703.3.2 Radar Detection System (RDS)

May be used for either advanced detection or presence detection. The radar detection system may be a multi-sensor system or a single-sensor system. A complete detection system including all mounting hardware, contact closure input card, and necessary materials for a fully functioning system meeting manufacturers' specifications shall be included. The format of the interface module shall comply with NEMA or California TEES.

703.3.2.1 PRESENCE RDS. Presence Radar shall have a minimum detection range of 100 feet and may be side-fire or forward-fire radar. The radar detection system shall provide at least 8 RF channels to mount multiple units in the same vicinity without interfering between them. Radar sensor shall be able to detect vehicles in 1 to 6 lanes of traffic. The Presence RDS is required to have automatic and/or manual configuration of lanes, stop bars, and zones.

703.3.2.2 ADVANCED RDS. Advanced Radar shall have a minimum detection range of 600 feet with forward-fire radar. Object speed detection shall be with a range of 0 to 99 miles per hour. The radar detection system shall provide at least 8 RF channels to mount multiple units in the same vicinity without interfering between them. Radar sensor shall be able to detect vehicles in 1 to 4 lanes of traffic as a minimum.

703.3.2.3 RADAR HOUSING. Radar housing shall be a weather tight sealed enclosure conforming to I-67, UL 746C and NEMA 250 Standards. The housing shall be resistant to corrosion, fungus, moisture deterioration, and ultraviolet rays. The housing shall permit the radar to be adjusted to allow proper alignment for actuate operations. The maximum mounting height shall not exceed 40 feet.

703.3.3 Combination Video / Radar Detection System (Hybrid)

Hybrid detection systems are not to be used unless specifically approved by the City of Wichita Traffic Engineer.

703.3.4 Loop Detector System

Loop detector sensor units provided shall, as a minimum, meet the specifications given Caltrans 332 or 336 Traffic Signal Control Systems, respectively. In addition, the following features shall be included: push-wheel or push-button switch to allow selection of a minimum of 8 pulse

sensitivities, 7 presence levels, and an "off" mode per channel; open loop test switch that displays previous faults on channel indicators while continuing to process and output valid detections; multiple channel sequential scanning; an inductance range of 20-2000 microhenries.

703.4 SIGNAL HEADS AND PUSHBUTTON SYSTEM

703.4.1 Traffic Signal Head Housing

The housing for each vehicle traffic signal section shall be made of a durable polycarbonate. The housing shall have an all-black finish. The visors for each signal section shall be of the tunnel type and be made of a durable black polycarbonate of not less than 3/32 of an inch thick. No reflectors shall be used.

These specifications are intended to provide the minimum requirements for polycarbonate traffic signals that will be acceptable.

- a) The housing shall be screw-injection molded polycarbonate resin and shall be of sectional construction to permit the installation of additional sections for future needs.
- b) The doors shall be screw-injection molded polycarbonate resin, which shall be internally hinged at the left side and with substantial screw or wingnut-type fasteners of stainless steel at the right side. Cam-type fasteners will not be permitted. The visor shall be of polycarbonate resin.
- c) All housings and doors shall be interchangeable.
- d) The housing shall be black with signal doors and visors a flat black. No painting shall be permitted. Color must be molded completely through the polycarbonate material and shall not require painting in future years.
- e) There shall be a terminal block in each head.
- f) All signals shall be adjustable type.
- g) All signals shall be shipped assembled with visors attached.
- h) Each box shall be marked to indicate the signal is intended for and the bid item number.
- i) A blank signal section shall consist of housing, door and gaskets.

703.4.2 Mounting Brackets

Brackets, clamps, etc. shall be furnished in accordance with the details on the plans and/or items listed in the bill of materials. The Contractor shall be responsible to advise the supplier of the exact intent of the plans regarding proposed signal mounting combinations and their corresponding signal orientation and signal head types and the requirements for other appurtenances, such as cabinets or signs. In this manner, it is intended that all fittings, spacers, bolts, clamps, etc. shall be furnished in sufficient quantity to effect complete mounting of the signal head(s) or other appurtenances whether or not each individual element is delineated or itemized on the plans.

703.4.2.1 MAST-ARM BRACKET. The mast arm signal mounting brackets shall be fabricated of high strength aluminum. They shall provide for rigid mounting of the traffic signal heads while allowing signal aiming adjustment in all planes. The brackets shall strap to the mast arm using aircraft-type cable which shall be pinned to the bracket at one end and shall provide a turnbuckle style tightening adjustment on the other. The brackets shall incorporate wiring channels so that after installation, all signal cables shall be protected from the effects of exposure to the weather.

703.4.2.2 SIDE-OF-POLE BRACKETS. Side-of-pole signal mounting brackets shall be steel or aluminum (no polycarbonate) that is black in color and shall incorporate a mounting arm and pole plate into a single member which shall include guides to correctly position the banding material on the pole plate. The dimensions of the mounting brackets shall be as required to provide proper signal head alignment. Each bracket shall have molded serrations to assure a positive lock with the signal head and allow positioning of the traffic signal heads in increments of 5 degrees. The bracket shall be designed to provide a wiring raceway for signal cable exiting the support pole and entering the signal head.

703.4.3 Retroreflective Backplate

All signals shall include 5" back plates with 2" reflective striping. Back plates shall be furnished and attached to the signal faces to provide a dark background for signal indications. Louver openings shall be positioned to prevent sunlight infiltration through backplate. They shall be fabricated from a minimum of 0.06-inch aluminum primed and painted flat black on both sides. They shall be capable of withstanding a 100 miles per hour wind. Backplates shall be furnished with all necessary hardware to attach to the signal heads.

703.4.3.1 REFLECTIVE STRIP. Backplates shall have 2-inch wide fluorescent yellow retroreflective strips affixed on all four sides of the traffic signal head and flush with the outside edge. Sheeting shall be 3M Diamond Grade DG3 ASTM D4956 Type XI Retroreflective Sheeting material. Strips shall be pressure rolled onto back plates.

703.4.3.2 MULTI-SECTION. Where a back plate comprises two or more sections, the sections shall be fastened with stainless steel bolts, opened after assembly to prevent loosening.

703.4.4 Vehicle Traffic Signal LED Modules

All LED modules must be approved by the City of Wichita.

703.4.4.1 ARROW MODULE. When specified in the Plans, LED lenses shall meet the most current ITE "Vehicle Traffic Control Signal Head: LED Vehicle Arrow Traffic Signal Supplement" publication. The arrow shield shall only allow light through the arrow display, with no extraneous light around the edges.

703.4.4.2 LED MODULE. When specified in the Plans, the lenses in each signal head shall be a 12-inch LED lens meeting the requirements of the most current ITE "Vehicle Traffic Control Signal Heads: LED Circular Signal Supplement" publication".

703.4.5 Pedestrian Traffic Signal LED Modules

The pedestrian traffic signal heads shall be of one-piece polycarbonate construction. The housing shall have an all-black finish. The visors on the one-piece heads shall be black. No egg crate type visors are permitted. The pedestrian signal indications shall be in general conformance with the latest edition of the ITE Pedestrian Traffic Control Signal Indicators - Light Emitting. Pedestrian lenses shall be rectangular, with a side dimension of 12 inches, or with dimensions of 18.5 inches wide by 18.75 inches high. The message shall consist of a Don't Walk "HAND" symbol in Portland Orange, and a Walk "WALKING PERSON" symbol in Lunar White.

703.4.5.1 COUNTDOWN PEDESTRIAN TRAFFIC CONTROL SIGNAL LENSES. A one-section pedestrian signal head lens shall be rectangular and have a side dimension of 16 inches and a width of 18 inches. The pedestrian symbols shall be a minimum of 6 inches high in accordance with the MUTCD. The pedestrian signal head, the symbols shall be a minimum of 9 inches high. The message shall consist of an upraised hand (symbolizing DON'T WALK) "HAND" symbol, and a Walk "WALKING PERSON" symbol. The upraised hand symbol shall be Portland Orange, and the walking person shall be White, with both indications conforming to the publication, "Pedestrian Traffic Control Signals Indications". Countdown pedestrian signals shall always be displayed simultaneously with the flashing upraised hand (symbolizing DON'T WALK) signal indication displayed for the crosswalk. The countdown pedestrian signals will consist of Portland Orange numbers at least 9 inches in height on a black opaque background. The countdown shall be located immediately adjacent to the associated upraised hand. The countdown will further be in accordance with the latest edition of the MUTCD (2009 MUTCD Section 4E.07).

703.4.5.2 LED PEDESTRIAN SIGNALS. Light-Emitting Diodes (LED) Pedestrian Signals shall meet all applicable standards in the latest edition of the ITE "Pedestrian Traffic Control Signal Indicator: LED Signal Modules". The symbol designs shall conform to those set forth in the "Standard Highway Signs and Markings" book. These signal indications shall be consistent with City Specification.

703.4.5.3 COUNTDOWN PEDESTRIAN TRAFFIC CONTROL SIGNAL LENSES. The module display shall have an overlaid symbol configuration. Signal modules must be moisture and dust resistant. Signal modules shall operate in an 80 VAC RMS to 135 VAC RMS Voltage range, (60 ±3 Hz AC).

703.4.6 APS Pushbutton System & Sign

APS shall be installed at all signalized intersections where pedestrian infrastructure is present or to be constructed. The Manual of Uniform Traffic Control Devices (MUTCD), latest edition, shall be the standards and guidance for APS and APS detector (pushbutton) placement in Section 4E.09 through 4E.13 (2009 edition). APS volume control shall automatically adjust in response to ambient sound levels as required by the current MUTCD, Section 4E.11 (02) "Accessible pedestrian signals shall have both audible and vibrotactile walk indications." (03) "Vibrotactile walk indications shall be provided by a tactile arrow on the pushbutton (see Section 4E.12) that vibrates during the walk interval." (04) "Accessible pedestrian signals shall have an audible walk indication during the walk interval only. The audible walk indication shall be audible from the beginning of the associated crosswalk." (05) "The accessible walk indication shall have the same duration as the pedestrian walk signal except when the pedestrian signal rest in walk." (07) "Where two accessible pedestrian signals are separated by a distance of at least 10 feet, the audible walk indication shall be a percussive tone. Where two accessible pedestrian signals on one corner are not separated by a distance of at least 10 feet, the audible walk indication shall be a speech walk message." (08) "Audible tone walk indications shall repeat at eight to ten ticks per second. Audible tones used as walk indications shall consist of multiple frequencies with a dominant component at 880 Hz.". The APS pushbutton system should include supplied 4-wire cable with individual P.I.M. modules.

703.4.6.1 PUSHBUTTON. The pedestrian push button assembly shall be an accessible pedestrian system and consist of an aluminum housing fitted with an easily accessible 2-inch ADA push button. Cover screws shall be stainless steel and the cover shall contain a silicon or neoprene cover to body gasket. The switch and actuator shall be protected from dust and moisture with a silicon or neoprene cover.

703.4.6.2 PEDESTRIAN SIGN. The pedestrian information signs shall bear the legend and size as detailed in the Plans. The sign size shall be MUTCD compliant with a minimum size of 9"x15". The sign blank shall be constructed of minimum 0.100-inch thick aluminum alloy. The sign face shall have a non-reflective black legend directly screened on white regular performance sign sheeting with anti-graffiti protective film overlay. The sign shall be visually accepted by the Engineer.

703.4.6.3 EXTENSION BRACKETS. APS extension brackets shall be furnished in accordance with the details on the plans and/or items listed in the bill of materials. Pushbutton extension brackets shall match pole color and be of similar material. The Contractor shall be responsible to advise the supplier of the exact intent of the plans regarding proposed mounting combinations. All fittings, spacers, bolts, clamps, etc. shall be furnished in sufficient quantity to complete mounting of the extension brackets.

703.4.7 Non-Functioning Traffic Signal Heads

All non-functioning traffic signal heads shall be covered with approved opaque coverings specifically manufactured for traffic signal heads.

703.5 TRAFFIC SIGNAL POLES

703.5.1 Traffic Signal Pole & Mast Arm (Steel)

The following specifications shall govern the design of steel mast arms with poles and bases unless otherwise specified:

703.5.1.1 COMPLETE ASSEMBLY. All items for complete assembly shall be furnished including, but not limited to:

- a) Arm with support shaft and base.

- b) Flange plates and bolts for attachment of mast arm to shaft.
- c) Anchor bolts with nuts and washers.
- d) Cover(s) for the exposed anchor bolts.
- e) Caps for top of pole and mast arm end.

703.5.1.2 DESIGN The complete assembly shall be designed in accordance with the loading and allowable stress requirements of 2013 AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, including interims. Loading shall be based on a wind load of 90 mph times a minimum 1.14 gust factor. The poles shall also accommodate wind loadings which may cause deflections of the mast arm in the vertical plane. These deflections shall never result in less than a 17-foot clearance between the roadway and the lowest point of the signal assembly.

A Letter of Certification from the manufacturer, and stamped by a registered Professional Engineer, shall be submitted certifying compliance to these specifications. If requested, calculations and detail drawings shall also be submitted for verification of compliance to these specifications.

703.5.1.3 STEEL TUBES. The tubular cross section shall be round and shall have a constant linear taper of 0.14 in./ft. or twelve sided and have a linear taper of 0.10 to 0.18 in./ft. They shall be fabricated from United States produced coil or plate steel conforming to the requirements of ASTM A595 grade A or ASTM A572, having a guaranteed minimum yield strength of 55,000 psi after fabrication. Tubular members 50' in length or less shall be of the same thickness throughout the entire length of the member.

703.5.1.3.a MAST ARMS. The mast arm shall have a horizontal length as called for on the plans. All mast arms shall be manufactured and shipped in one piece. Two-piece mast arms, joined by a slip over joint, will not be acceptable for mast arms less than 54.0 feet in length. A wiring grommet for 1.50" through holes shall be provided for each signal head, internally illuminated street name sign or other required fixture. See Section [702.19.1.5](#) of these specifications for additional hole requirements.

703.5.1.3.b POLE SHAFTS. 4" x 6.5" hand hole shall be welded into the shaft at 1.5' from the base of the pole and located 180 degrees from the mast arm. A cover shall be provided for the hand hole. Pole top caps shall be provided and shall be secured in place with set screws or other suitable fasteners. A "J-hook" wire support and grounding attachment shall be provided in each pole shaft.

703.5.1.4 COMBINATION POLES. When combination lighting and signal poles are specified in the Plans, the poles shall include welded connections for attaching the luminaire arm to the pole shaft. Clamp-on style luminaire arms are not permitted. The pole shaft shall be pre-drilled for the luminaire arm attachment prior to galvanizing, with the luminaire arm to be mounted in the same vertical plane as the signal arm or as shown in the plans. In addition, a reinforced nominal 3 inch by 5-inch hand hole shall be located 180 degrees from and just above the mast arm, and a J or C hook wire support shall be welded inside the pole just above the mast arm.

703.5.1.5 ANCHOR BOLTS. Anchor bolt material shall have a minimum yield strength of 55,000 psi and the bolts shall be galvanized to ASTM A153 for a minimum of 8" on the threaded end. Each anchor bolt shall be supplied with two hex nuts and two flat washers. A direct tension indicator (DTI) washer per bolt should be supplied. The strength of the nuts shall equal or exceed the proof load of the bolts. The anchor bolt sizes are to be standardized as shown on the contact documents. See section 703.5.1.11 for material certification requirements.

703.5.1.6 BASE PLATE. The base plate shall be of the steel meeting or exceeding the requirements of ASTM A36. It shall be integrally welded to the pole shaft with either a telescopic welded joint or a full penetration butt weld with a backup bar.

703.5.1.7 MAST ARM ATTACHEMENT. Arm and pole mounting plates shall be provided. The mast arm plate shall telescope the mast arm and be circumferentially welded inside and out. The pole plate shall be attached to the pole shaft by welded gusset plates at the top, bottom, and sides. Four high strength bolts with nuts meeting ASTM A-325 shall be furnished for the arm to pole attachment. Smooth holes shall be provided in the two plates to allow the signal cable to go from the pole to the arm without exposure to the outside weather. Tapped holes to have bolts installed completely.

703.5.1.8 IDENTIFICATION. The manufacturer shall permanently mark each mast arm and pole to identify them with their corresponding Traffic Signal Pole Summary item number. All hardware is to be packed on a per pole basis.

703.5.1.9 GALVANIZING. The traffic signal pole and arm shall be galvanized in accordance with ASTM A123. Each component must be completely coated in a single dip. No double dipping will be allowed. All miscellaneous hardware shall be galvanized per ASTM A153.

703.5.1.10 WELDING. Welding shall be in accordance with American Welding Society (AWS) Structure Welding Code D1-1 Sections 1 through 6 and shall be performed by welders certified in accordance with the AWS Code. The tube's longitudinal seam welds shall be free of cracks and undercutting, performed with automatic processes, and visually inspected with questionable areas inspected by magnetic particle to AWS D1.1.

703.5.1.11 MATERIAL CERTIFICATIONS. All materials and products shall be produced in the United States of America. They shall be of the ASTM type as called forth in this specification. If requested, mill certifications shall be supplied for proof of compliance to this specification. All certifications, including anchor bolts, should be made available to the Engineer and supplied with required shop drawings.

Anchor bolts shall require a Kansas Department of Transportation (KDOT) Type "A" material certification (certified mill test report). See KDOT specifications sections 1615 and 2601 for additional details.

703.5.1.12 FABRICATOR. Fabricator shall be certified under Category I, "Conventional Steel Structures" as set forth by the American Institute of Steel Construction's Quality Certification Program and have a full-time structural Engineer on staff. Proof of this certification will be required prior to bid opening to assure that the fabricator has the personnel, organization, experience, procedures, knowledge, equipment, capability, and commitment to fabricate quality Traffic Signal Pole Structures.

703.5.2 Traffic Signal Pedestal (Aluminum)

The pedestal and base shall be designed to withstand a wind load of 100 mph with a 25 percent gust factor while supporting a one-way, three section, 12" aluminum traffic signal head. The shaft shall be wrapped with protective paper for shipment. Large scratches or gouges in the aluminum material shall be cause for rejection.

703.5.2.1 SHAFT. The shaft shall be a one-piece tube of 6063-T6 aluminum alloy with a minimum wall thickness of 0.237". The shaft shall be of uniform diameter throughout length. The shaft outside diameter at the top shall be approximately 4.5". Overall height of the shaft and base shall be 10 feet. The shaft shall have a satin brush finish. The shaft shall be fully threaded with a nominal 4" pipe thread and be threaded into the base and tightened per manufacturers guidelines. The base and shaft are to include a base collar assembly.

703.5.2.2 BASE. The base shall be equipped with a hand hole and door for access to the interior of the base. The hand hole shall have a minimum dimension of 7 3/4" by 8". The door shall be fastened in place by a single bolt which shall have an Allen head to discourage unauthorized personnel from gaining access to the wiring compartment in the pedestal base. The pedestal base shall be mounted to a poured concrete pad by means of four anchor rods set in a bolt circle. There

shall be a provision in the base for the attachment of a ground wire. Base shall be FHWA certified and meet or exceed AASHTO break-away requirements.

703.5.2.3 BASE COLLAR. A base collar shall be installed for the pole and base assembly. The collar should be aluminum and match the shaft finish.

703.5.2.4 HARDWARE. Anchor rods shall be 3/4" diameter by 12 feet long plated and shall be supplied with square line nuts and square line washers.

703.5.3 APS Pushbutton Station

APS pushbutton station shall be in accordance with the plans and detail sheets.

703.5.3.1 SHAFT. The shaft shall be a one-piece tube of 6063-T6 aluminum alloy with a minimum wall thickness of 0.237". The shaft shall be of uniform diameter throughout length. The shaft outside diameter at the top shall be approximately 4.5". Overall height of the shaft and base shall be 10 feet. The shaft shall have a satin brush finish. The shaft shall be threaded with a nominal 4" pipe thread and be threaded into the base. The base and shaft are to include a base collar assembly.

703.5.3.2 BASE. The base shall meet Traffic Signal Pedestal (Aluminum) base requirements. See [Specification 703.5.2.2](#).

703.5.3.3 BASE COLLAR. A base collar shall meet Traffic Signal Pedestal (Aluminum) base collar requirements. See [Specification 703.5.2.3](#).

703.5.3.4 HARDWARE. Anchor rods shall be 3/4" diameter by a minimum 12" long plated and shall be supplied with square line nuts and square line washers.

703.5.4 Span Wire Poles

The following specifications shall govern the design of steel span wire poles and appurtenances unless otherwise specified:

703.5.4.1 COMPLETE ASSEMBLY. All items for complete assembly shall be furnished including, but not limited to:

- a) Tapered steel shaft with base.
- b) Hand hole with cover.
- c) Cap for top of pole.
- d) Span wire clamps.
- e) Steel wire entrance (weather head).
- f) Anchor bolts with nuts and washers.
- g) Covers for exposed anchor bolts.
- h) Galvanized thimbles at connections to reduce strain, abrasion, and kinking of wire.

703.5.4.2 DESIGN. The total assembly shall be designed to support, by means of a span wire and tether, the various equipment listed. The pole shall provide a minimum clearance of seventeen feet and six inches (17'-6") from the pole base elevation to the tether wire, with a span wire sag of three one-half to five percent (3 1/2 to 5%).

The pole shall be a minimum ANSI Class 4 utility pole with a minimum length of thirty-five feet (35').

The manufacturer shall provide an information sheet showing design details of the pole, anchor bolts, flange construction, orientation of anchor bolts, recommendation for back rake, and any other pertinent installation instructions.

703.5.4.3 ANCHOR BOLTS. Anchor bolt material shall have a minimum yield strength of 55,000 psi and the bolts shall be galvanized to ASTM A153 for a minimum of 8" on the threaded end. Each

anchor bolt shall be supplied with two hex nuts and two flat washers. The strength of the nuts shall equal or exceed the proof load of the bolts.

703.5.4.4 ANCHOR BASE. A one-piece steel anchor base with a sixteen-inch (16") or twenty inch (20") bolt circle, exceeding the requirements of ASTM A-36. It shall be integrally welded to the pole shaft with either a telescopic welded joint or a full penetration butt weld with a backup bar.

703.5.4.5 POLE SHAFT. The shafts shall be fabricated plate steel conforming to regulations of ASTM A-5909 or ASTM A-572 for a guaranteed minimum yield strength of 55,000 psi after fabrication.

703.5.4.6 ACCESS HOLE. A manhole with a minimum area of twenty-five square inches (25 sq. in.) shall be welded into the shaft a short distance from the base. A cover shall be provided for the manhole.

703.5.4.7 POLE CAPS. Pole top caps shall be provided and shall be secured in place with set screws or other suitable fasteners.

703.5.4.8 OTHER

703.5.4.8.a WIRE SUPPORT. A "j-hook" wire support shall be provided in each pole shaft.

703.5.4.8.b GROUNDING ATTACHEMENT. Provision shall be made for a grounding attachment.

703.5.4.8.c SPAN WIRE CLAMPS. Span wire clamps shall be provided to attach two span wires.

703.5.4.8.d ENTRANCE HEAD. A steel, wire entrance (weather head) shall be provided for each pole.

703.5.4.9 IDENTIFICATION. The manufacturer shall permanently mark each pole to identify it with the corresponding traffic signal pole summary item number.

703.5.4.10 GALVANIZING. The traffic signal pole and arm shall be galvanized in accordance with ASTM A-123. Each component must be completely coated in a single dip. No double dipping will be allowed. All miscellaneous hardware shall be galvanized per ASTM A153.

703.5.4.11 WELDING. Welding shall be in accordance with American Welding Society (AWS) Structure Welding Code D1-1 Sections 1 through 6 and shall be performed by welders certified in accordance with the AWS Code. The tube's longitudinal seam welds shall be free of cracks and undercutting, performed with automatic processes, and visually inspected with questionable areas inspected by magnetic particle to AWS D1.1.

703.5.4.12 MATERIAL CERTIFICATIONS. All materials and products shall be produced in the United States of America. They shall be of the ASTM type as called forth in this specification. If requested, mill certifications shall be supplied for proof of compliance to this specification.

703.5.4.13 FABRICATOR. Fabricator shall be certified under Category I, "Conventional Steel Structures" as set forth by the American Institute of Steel Construction's Quality Certification Program. Proof of this certification will be required prior to bid opening to assure that the fabricator has the personnel, organization, experience, procedures, knowledge, equipment, capability, and commitment to fabricate quality Traffic Signal Pole Structures

703.6 SERVICE BOX

Service boxes shall be in accordance with the plans and details sheets. The cover shall bear the logo "TRAFFIC SIGNAL" clearly and permanently molded or etched into the cover. Service boxes may be cast-

in-place per detail sheets or from an approved precast manufacturer. Wood shims for permanent installations will not be accepted. Adjustments shall be made with concrete, brick, and grout or as approved by the Engineer.

703.7 STREET LIGHTING

703.7.1 Luminaire Arm

Luminaire arms shall be truss-type arms as indicated in the plans. All luminaire arms shall have suitable welded attachment devices for attachment to the pole shaft. Clamp-on style luminaire arms are not permitted. Truss-type arms shall be furnished with two simplex fittings as detailed in the plans.

703.7.2 Luminaires

LED luminaires shall have a housing of aluminum alloy casting, capable of mounting to a 2"-inch mast arm and be in compliance with ANSI C136-37. They shall be IP-66 rated for optical assembly and IP-65 rated for electrical components and shall have the following: three-hole terminal blocks for incoming #10 AWG AC lines; minimum 10kV/5kA surge protection, a 7-pin photo control receptacle with electronic photo control or shorting cap; and an electronic dimmable driver (power supply, rated for 100,000 hours). They shall be fully tested in accordance with IESNA Standard LM-79, pre-wired for installation, and shall maintain 70% of initial lumen output after 100,000 hours of operation. LED luminaire criteria: (lumen output, luminaire wattage, lumens per watt (minimum 100), input voltage, bug rating (max B3-U0-G3), CCT (4000k +/- 300k), CRI (minimum 70) photometric requirements, and distribution); and the photometric performance criteria (maintained illumination, avg/min and max/min uniformity ratios) shall be determined by the project designer and noted in the plans. Designers shall conform to the IESNA standard RP-8-14 for required illumination.

703.7.3 Photocell

The photocell shall be solid type, 1000 Watt/1800 Volt-amps maximum, single pole, single throw, twist lock mounting, 120 Volt operation. The operating levels shall be 1.5 foot-candle ON and 0.33 foot-candle OFF, with an allowable variation of 0.5 foot-candle ON or OFF. The photocell shall have a minimum of a 30 second time delay OFF and fail in the ON mode.

703.7.4 Un-Fused Street Light Connector Kit

Un-fused connector kits shall be of the set-screw type sized to the conductors specified in the Plans. They shall be furnished with waterproof rubber boots.

703.7.5 Fused Street Light Connector Kit

Fused connector kits shall be sized to the conductors specified in the Plans and shall be supplied with molded rubber boots for waterproofing. The connector shall be capable of withstanding multiple disconnects without damage to the watertight seals or terminals. Each connector shall include all parts and materials necessary to complete its installation, such as fuses, lubricating compound, and assembly devices.

703.7.5.1 FUSE. The fuse shall be a minimum of 5-amp cartridge type as recommended by the connector manufacturer.

703.8 SIGNING

703.8.1 Overhead Street Name Sign

This specification covers finished reflectorized street name signs specifically designed to inform a motorist of the identity of the approaching street.

703.8.1.1 METAL BACKING. The material shall be 0.125-gauge, aluminum alloy 6063T6 or aluminum alloy 5052-H38, with all corners rounded.

703.8.1.2 REFLECTIVE BACKING. All sign faces shall have a green background with white legend and shall be covered with 3M Diamond Grade DG3 ASTM D4956 Type XI Retroreflective Sheeting material. All legends and borders shall be silver in color while backgrounds shall be green in color. All signs shall have silver legends and borders on green backgrounds on only one side of the

aluminum blank. The finished signs shall be of good appearance, free from ragged edges, cracks, scales or blisters, and the legend shall be clear-cut.

703.8.1.3 LEGEND. The sign shall meet all requirements of the MUTCD and as shown in the standard sheets. The overhead sign shall be composed of initial uppercase letters of 12 inches in height and lower-case letters 9 inches in height. All letters shall be Series D. Supplementary lettering to indicate the section of the city (such as NW) may be in smaller lettering, composed of letters at least 6 inches in height. Conventional abbreviations (as shown in 2009 MUTCD Section 1A.15) may be used except for the street name itself. A pictograph may be used on a sign. All signs shall have legends centered on face with the letters sized and spaced to produce a readable, professional quality sign.

703.8.1.4 BORDER. All borders shall be 3/4" wide white material.

703.8.1.5 ACCEPTANCE. Before final fabrication and shipment, the manufacturer or supplier shall provide, for the Engineer's approval, a layout of each sign showing the exact street name lettering to be placed on the sign. The signs shall be visually accepted by the Engineer.

703.8.2 Regulatory Signs

The design details (color, letter height and letter series) for all regulatory signs shall be as shown in the latest edition of the FHWA Standard Highway Signs and Pavement Markings Book and the MUTCD. Special signs not covered by the Standard Highway Signs Manual or MUTCD shall be as shown in the Plans. Sign blanks shall be a minimum of 0.080-inch-thick aluminum alloy. The sign face shall be a minimum Type IV High Intensity Prismatic (HIP) grade Retroreflective Sheeting material.

703.8.2.1 ACCEPTANCE. Regulatory signs included in the Traffic Signal bid item will be accepted in accordance with these specifications, with additional certification stating that the High Intensity Retroreflective sheeting used to manufacture the signs was pre-qualified.

703.8.2.2 SIZE. The sign size shall meet requirements as shown in the MUTCD.

703.8.3 Blank Out Sign

The blank out sign legend shall be as indicated in the Plans. When energized, the sign message shall be clearly legible under any lighting conditions. It shall completely blank out when not energized. No phantom legend shall be seen under any ambient light condition. The housing shall be durable and weatherproof. The sign face shall consist of an LED display arranged to define the legend. The sign shall be fully compatible with the traffic signal system and conflict monitor. The sign shall be capable of continuous operation over a temperature range criteria of NEMA TS2 standard from -34 degrees to +74 degrees Celsius.

703.8.3.1 SIZE. The sign size shall meet requirements as shown in the MUTCD. Blank out signs shall comply with the provisions of the applicable Section for the specific type of sign, provided that the letter forms, symbols, and other legend elements are duplicates of the static messages as detailed in the "Standard Highway Signs and Markings" book. Because such a sign is effectively an illuminated version of a static sign, the size of its legend elements, the overall size of the sign, and placement of the sign should comply with the applicable provisions for the static version of the sign.

703.9 MAJOR ELECTRICAL EQUIPMENT

All electrical systems and equipment shall conform to the standards of the National Electrical Manufacturers Association (NEMA). In addition to the requirement of these Specifications, all material shall conform to the requirements of the National Electrical Code (NEC), the Standards of the American Society of Testing Materials (ASTM), the American Standards Association (ASA), and local ordinances.

703.9.1 Service Disconnect

Each service disconnect must be furnished with an installed lightning arrest on the AC service input which meets or exceeds the following requirements:

- a) The unit must be capable of withstanding repeated 20,000 ampere surges (min. of 20).
- b) The unit must have internal follow - current limbers (resistive elements).
- c) The unit must contain three active clamping stages minimum.
- d) The unit must self-extinguish within 8.3 milliseconds after the trailing edge of the surge.
- e) The parallel impedance of limbers must be less than 0.15 OHMS.
- f) The unit shall be UL approved.

703.9.2 Entrance Head

The entrance head shall be of cast aluminum and shall be of the clamp-on type for use with rigid conduit. It shall be U.L. listed.

703.9.3 Service Enclosure

The service enclosure shall be watertight and be of sufficient size and load rating to provide the number of circuits indicated in the Plans. The enclosure shall be provided with a hasp for a padlock. Padlocks will be provided by others.

703.9.4 Circuit Breakers

The circuit breakers shall be standard plug-in, single pole, molded case, of the trip rating as shown in the Plans.

703.9.5 Surge Arrestor

The surge arrestor shall be protected with a 15 AMP-2P Breaker for 120/240 VAC as shown in the Plans.

703.9.6 Power Service Enclosure Cabinet

The power service enclosure cabinet must be furnished and installed which meets or exceeds the following requirements:

703.9.6.1 CABINET CONSTRUCTION. The controller cabinet shall be constructed of 5052 alloy aluminum with a minimum thickness of 0.125" (inch) and natural aluminum finish. The cabinet shall be of clean-cut design having no sharp edges, corners, or projections and NEMA 3R construction.

703.9.6.2 SIZE. The enclosure shall be a 16" size for a single meter and 24" for double meter. Use size as shown in the plans. The enclosure shall increase in size with the number of circuits. Mounting base should be included for concrete pad-mounting.

703.9.6.3 METER. Cabinet shall be meet the current energy company requirements. This includes an exposed meter cabinet, 200A, jaw-clamping lever-bypass meter socket with factory installed fifth terminal at 9:00 position.

703.9.6.4 SERVICE ENTRANCE. Service entrance in back of controller shall have a hinged or a lift off cover with pad lock provisions.

703.9.6.5 SECONDARY BREAKER. The secondary breaker for the photo-cell circuit shall be 277 volt, 15 amp single pole.

703.9.6.6 SPLIT BUS LOAD CENTER. The bus load center should include the following unless shown otherwise in the plan documents.

- Unswitched (constant) load center with 50A 2P; 30A 1P and 30A 2P breakers
- Switched load center with electrically held contactor controlled by photocell receptacle and Hand-Off-Auto Switch, 30A 1P and 30A 2P breakers.

703.9.6.7 WIRING. The wiring from PB1 and PB2 to T1 through T4 shall be No. 6 AWG THW. The wiring for the load and line side of the main breaker shall be the same size with the wire. The wiring for the photo electric control circuit shall be No. 12 AWG THW.

All wiring and wiring methods shall comply with the most current National Electric Code standards. Any changes to these standards shall be approved by the authority having jurisdiction.

703.9.6.8 CATALOG NUMBERS OR APPROVED EQUAL. Use Milbank power service meters below (or approved equal):

16" cabinet catalog #CP3B51C14PAOSL1

24" cabinet catalog #CP3B51C14RAOSL1

Shop drawings shall indicate if cabinet size, system voltage, or load centers vary from standard. Enclosures other than approved or on PQL shall be reviewed and approved by the City in writing.

703.10 GROUNDING

All grounding systems shall be in accordance with the National Electric Code (NEC) and manufacturer specifications.

703.10.1 Ground Rod

The ground rod shall be $\frac{3}{4}$ inch diameter by 12' or 20' feet long as indicated in the plans and [Section 702.22.2](#). Rods shall be copper bonded steel rod and bear the U.L. label for steel poles.

703.10.2 Ground Clamp

The ground rod clamp shall be a $\frac{3}{4}$ inch clamp cast of high strength copper alloy and be U.L. listed for direct burial.

703.10.3 Ground Bus

The ground bus shall meet the requirements of Section 8 of the NEMA Standards. A ground bus shall be provided in each cabinet. It shall be connected to the approved grounding rod in the cabinet.

703.10.4 Ground Wire

All ground wire shall be No. 6 AWG copper wire meeting the requirements of ASTM B-3. Solid bare copper wire shall be used for all exterior installations including service and ground rod bonding. Otherwise, green insulated stranded wire type "THHN/THWN" shall be used.

703.11 WIRING

All wire and cable supplied under this specification shall be approved based upon catalog cuts submitted to the Engineer. In addition, all wire and cable shall be visually inspected by the Engineer. Any apparent defect that may shorten the service life of the wire or cable shall be cause for rejection. Unless specifically identified, solid wire shall be used in signal cable, exterior installations, and wires connected to ground wire. Stranded wire shall be used for all other wiring.

703.11.1 Service Wire

Intersection signalization power supply wire shall be single conductor wire for operation on a 600V maximum, and suitable for use at conductor temperatures not exceeding 75 degrees Celsius. Material, construction, and tests shall be in accordance with the applicable requirements of the ICEA Standard S-66-524 "Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy".

Conductors shall be stranded, annealed coated copper type THHN/THWN. Copper wire, before insulating or stranding, shall meet the requirements of the latest edition of ASTM B-33 (for coated wire). Stranding shall be Class B, in accordance with the latest edition of STM B-8.

Refer to drawings for size and type of wire required.

The service wire shall be Type USE-2 stranded, annealed, copper wire meeting the requirements of ASTM B-8, and be of the size specified in the Plans.

703.11.2 Lighting Distribution Wire

The lighting distribution wire shall be Type USE-2 stranded, annealed, copper wire meeting the requirements of ASTM B-8, and be of the size specified in the Plans.

703.11.3 Pole and Bracket Wire

The pole and bracket wire shall be Type USE-2 stranded, annealed, copper wire meeting the requirements of ASTM B-8, and be of the size specified in the Plans.

703.11.4 Ground Wire

See "Ground Wire" [Section 703.10.4](#).

703.11.5 Tracer Wire

Provide Blue No. 12 AWG tracer wire with tracer wire connectors. Tracer wire and connectors shall meet approved materials located in Section 800 (Water).

703.11.6 Tracer Wire Connector

Provide a solid brass, bronze alloy, or copper clad steel split bolt type connector as shown in standard drawings that accepts No. 12 AWG tracer wire without the addition of crimp or other connectors. The split bolt should be 1/4" in diameter with a stud that is accessible from outside the cabinet. The connector shall be completely isolated from the cabinet and grounding circuit with non-conductive flange washers. Rubber isolators are not allowed.

703.11.7 Multi-Conductor Wire

The multiconductor cable shall meet the requirements of IMSA 19-1. Conductors shall be solid No. 14 AWG. The number of conductors shall be as indicated in the Plans.

Conductor cable for intersection signalization shall be multi-conductor cable of the size specified on the plans for operation on a 600V maximum, and suitable for use at conductor temperatures not exceeding 75 degrees Celsius. Material, construction and tests shall be in accordance with the applicable requirements of the Insulated Cable Engineers Association Standard S-6L-402 "Thermoplastic Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy".

Conductors shall be solid, annealed, uncoated copper or annealed, coated copper. Copper wire before insulating or stranding shall meet the requirements of the latest edition of ASTM B-33 (for coated wire) or STM B-3 (for uncoated wire). Stranding shall be Class B, in accordance with the latest edition of STM B-8.

Insulation for the individual conductors shall consist of a 20 mil thickness of polyethylene, and an insulation covering of a polyvinyl chloride compound with a 10 mil thickness.

The polyethylene insulation shall meet the requirements of paragraph 3.9 of ICEA Standard S-61-402 before application to the conductor, and paragraph 3.9.1 after application to the conductor.

The polyvinyl chloride insulation covering shall meet the requirements of paragraph 4.3.1 of ICEA Standard S-61-402 and shall be color coded in accordance with Method 1, Part 5 of ICEA Standard S-61-402.

The overall cable jacket shall consist of a polyvinyl chloride compound which will provide a tough, heat, moisture, ozone, and flame resistant covering meeting the requirements of paragraph 4.3.1. of ICEA Standard S-61-402. The overall jacket thickness shall be in accordance with Table 18, Part 4, ICEA Standard S-61-402.

Conductor cable conforming to the requirements of Specification 19-1 of the International Municipal

Signal Association (IMSA) may be used in lieu of above.

Conductor cable used for the signal control circuits shall be #14 AWG multi-conductor cable, meeting the above requirements.

703.11.8 Messenger Cable

The messenger cable used for support of overhead communications and detector lead-in cable shall be fabricated of seven zinc-coated, steel wires, Class A galvanized in accordance with STM A-475 and twisted into a single concentric strand. The tensile strength of the 5/16-inch messenger cable shall equal or exceed 6,000 pounds.

The contractor is to provide certification that the messenger cable has been tested and meets the required tensile strength.

703.11.9 Detection Cable

Power cable shall be sufficient with a minimum of 22 gauge for transmitting the required power. In cases where cable runs could exceed 1000' (feet), an 18 gauge cable may be necessary to ensure sufficient power without significant loss of power.

703.11.10 Loop Wire

703.11.10.1 SHIELDED LOOP DETECTOR LEAD-IN CABLE. Unless otherwise specified, shielded loop detector lead-in cable shall be Belden 8720 #14 AWG. The conductor and drain wires shall be tinned copper wires. The conductors shall be shielded by a layer of aluminum bonded to polyester film. All wires shall have polyethylene insulation and a jacket of vinyl. Shielded detector lead-in cable shall meet the requirements of IMSA 50-2. Conductors shall be No. 14 AWG stranded.

703.11.10.2 LOOP DETECTOR WIRE. The loop wire shall be No. 14AWG Stranded Copper with Type THHN or THWN insulation with UL approval and 600v rating. The detector loop wire shall meet the requirements of IMSA 51-5. The conductor shall be No. 14 AWG, and the tube shall be of polyethylene.

703.11.10.3 PRE-FORMED LOOPS. Pre-formed loops shall be factory assembled loops having the dimensions and number of turns of wire specified in the Plans. The loops shall be constructed of a minimum No. 16 AWG Type TFFN/THWN copper wire meeting the requirements of ASTM B-8 and encased in heavy duty tubing compatible with the paving material being used on the project. The tubing shall be completely filled with asphalt sealant material after the wire is installed. The loop tail shall be of flexible tubing of the length specified in the Plans and shall also be filled with asphalt sealant material. The detector wire within the loop tail shall be twisted a minimum of 3 turns per foot.

703.11.10.4 LOOP WIRE SEALANT. The saw slot filler and encapsulate shall be a one-part polyurethane, moisture curing, elastomeric compound requiring no mixing, measuring or application of heat prior to or during its installation and designed specifically for sealing and protecting vehicle detector loop wires installed in saw cuts 1/4" to 3/8" wide and 3 1/2" deep.

The loop sealant shall be a one-part polyurethane, moisture curing, elastomeric compound requiring no mixing, measuring, or application of heat prior to or during application. It shall be specifically designed for sealing and protecting detector loop wires in both asphalt and concrete pavements. It shall not chemically attack or damage the pavement yet shall sufficiently bond with the pavement to effectively seal the saw cut and prevent the infiltration of moisture into the slot. The cured loop sealant shall exhibit resistance to the normally encountered effects of weather, vehicular abrasion, motor oils, gasoline, antifreeze solution, brake fluid, deicing chemicals, and salt in such manner that the performance of the detector loop is not adversely affected. The loop sealant shall provide compressive yield strength to withstand normal vehicular traffic and prevent the intrusion of rocks, glass, and other road debris into the slot. It shall remain sufficiently flexible

at all normally encountered temperatures to withstand normal movement in asphalt and concrete pavements while protecting the loop wire from fracture and shear.

703.11.11 Ethernet Cable

Use outdoor-rated Cat 6 or higher cable with UV resistant outer jacket and soft drawn copper conductors. Use a gel-free, paper-based water stop cable for cabinet and outdoor installations. Furnish plenum rated cable for installations inside of buildings or shelters. Use RJ-45 connectors that are gold plated, shielded, and allow for Power-Over-Ethernet (POE).

703.11.12 Span Wire (Strain Wire)

Use ASTM 370 Grade High Strength Strain wire with a minimum diameter of 3/8". Strain and tether wires shall include galvanized thimble(s) at connections to reduce strain, abrasion, and kinking of wire.

703.12 CONDUIT & FITTINGS

703.12.1 Galvanized Rigid Steel Conduit (GRC)

Metallic conduit shall be galvanized rigid steel conduit meeting the requirements of ANSI C80.1. Metallic conduit fittings shall be zinc coated and shall meet the requirements of ANSI C80.2.

All conduits shall be hot dipped galvanized rigid steel conduit, UL approved, and meet Federal Specifications WW. C-581-D and/or American Standard #080-1.

Conduit shall meet the requirements of Federal Specification WW.C-581-D or American Standard 081-1 for Rigid Galvanized Steel Conduit.

703.12.2 High Density Polyethylene Conduit (HDPE)

Polyethylene conduit shall be coilable, smooth wall Schedule 80, high density polyethylene duct meeting the requirements of NEMA Standard TC-7.

703.12.3 Polyvinyl Chloride (PVC)

Conduit shall be a minimum of Schedule 40 Polyvinyl Chloride (PVC) pipe. PVC conduit shall be either Schedule 40 or Schedule 80 rigid polyvinyl chloride. PVC conduit and conduit fittings shall meet the requirements of the latest NEMA Standard. The conduit and fittings shall bear the U.L. label.

703.12.4 Pull Rope

Provide polypropylene pull rope with a minimum tensile strength of 1,125 lbs.

703.13 LABELING EQUIPEMENT

Use self-laminating vinyl or polyester labels at least 3/4-inch wide and long enough that the translucent portion of the label completely covers the white area bearing the legend. Use vinyl or polyester with a layer of pressure sensitive acrylic adhesive. Use labels that resist oil, water, and solvents and are self-extinguishing. Use a machine to print the legend in letters at least 1/8 inch high.

703.14 CRUSHED ROCK BEDDING

Crushed rock used in bottom of service and junction boxes as shown on the standard details shall be drainable 3/4-inch clean gravel. This aggregate will be visually accepted by the Engineer.

703.15 CONCRETE

Material requirements for all concrete supplied for the work shall be in accordance with City of Wichita Specifications Section 406 "Portland Cement Concrete Pavement".

703.16 STEEL REINFORCMENT

All reinforcing steel shall meet the requirements of concrete reinforcement in City of Wichita Specifications Section 406.2 for "Steel Reinforcement".

703.16.1 Steel Bar

Reinforcing steel for concrete shall be deformed billet-steel bars conforming to the requirements for Grade 40 in the latest revision of Standard Specification for Deformed Billet Steel Bars for Concrete Reinforcement (ASTM A-615).

703.16.2 Welded Wire Fabric (WWF)

Welded steel wire fabric used as reinforcement for concrete shall conform to the latest revision of ASTM A-185. Gages, spacing, and arrangement of wires and dimensions of units in flat sheet form or rolls shall conform to the requirements as specified by the plans or contract.

703.16.3 Fiber Reinforcement

At no time may fiber reinforcement be used in lieu of steel reinforcement.

703.17 ANCHOR BOLTS

The anchor bolts shall be the size and design recommended by the manufacturer of the particular pole to be installed. The anchor bolts shall have a minimum yield of 55,000 psi and shall be hot dipped galvanized to ASTM A153. The galvanizing shall include all threads and not less than 8 inches of the adjacent unthreaded portion of the bolts. Anchor bolts shall be threaded to a length shown on the Plans or in the Standard Details. Threads shall be Coarse Thread Series as specified in ANSI B1.1 and may be formed by cutting or rolling. Nuts for anchor bolts shall be Heavy Hex leveling nuts and Heavy Hex nuts as specified in ANSI B18.2.2. Nuts shall comply with the proof load or Brinell hardness requirements of ASTM A307. After galvanizing, the thread fit of the bolt-nut combination shall be snug and shall be such that the nuts can be turned on the bolts without the application of excessive torque. The Engineer may conduct proof load tests on the bolt-nut combination to check the thread fit.