CITY OF BRYAN, TEXAS

SPECIAL PROVISIONS FOR TRAFFIC SIGNAL INSTALLATIONS

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SPECIAL PROVISIONS FOR TRAFFIC SIGNAL INSTALLATIONS CITY OF BRYAN, TEXAS

1.0 GENERAL SPECIFICATIONS FOR CONSTRUCTION OF TRAFFIC SIGNALS

- 1.1 This specification and the Bryan/College Station Unified Design Manual, Technical Specifications from the Texas Department of Transportation's Standard Specifications for Construction and Maintenance of Highways, Streets and Bridges, and Standard Construction Details, where applicable, shall govern the materials and installation of traffic control signals, including illumination, at the intersections. In the event of a conflict, the special provision shall control.
- 1.2 Contractor shall furnish all required materials and equipment not provided by the City as described in the Bid Proposal attached and shall activate completed signals and signal systems as directed by the City Engineer. (Wherever the term "City Engineer" is found, it shall mean City Engineer or his/her designated representative.)
- 1.3 All installation work shall be in accordance with the applicable sections of the National Electrical Code, local ordinances and regulations, any plans, these special provisions, and those sections of the Bryan/College Station Unified Design Manual, Technical Specifications from the Texas Department of Transportation's Standard Specifications for Construction and Maintenance of Highways, Streets and Bridges, and Standard Construction Details. All workmanship shall be first class, and finished work shall be neat and uncluttered in appearance. The Contractor shall schedule his/her work so as to cause the minimum interference with traffic.
- 1.4 The Contractor's responsibility in regard to Traffic Signal installation work shall consist of the following items:
 - 1.4.1 Furnish and/or install signal equipment including: controller cabinets, controller foundations, signal structures and foundations, pedestal poles and foundations, conduits, wiring, ground boxes, signal head assemblies, video detector units, confirmation lights, priority control system detectors, conductors, concrete, reinforcing steel, forms for structure foundations, grouting materials, signs, miscellaneous nuts, bolts, and washers, and all other miscellaneous equipment that is required to complete the project, including all necessary barricades or devices required to maintain proper traffic control in accordance with the <u>Texas</u> <u>Manual on Uniform Traffic Control Devices.</u> (TMUTCD)
 - 1.4.2 Install luminaires on signal support poles, where appropriate.
 - 1.4.3 The City of Bryan will provide (where specified) the contractor with signal controllers, controller cabinets, and additional signal hardware, including conflict monitors, load switches, relays, flashers, and detector amplifiers, opticom priority control system detectors, signal poles, mast arms, luminaires with mast arms, and pedestal poles. The contractor is responsible for obtaining all other equipment and materials required to complete this project. The

contractor shall transport all equipment provided by the city to the construction site without damage. The City Representative (City Engineer and his/her assistants) will identify any damage done to the equipment and mark damaged items in the field. The Contractor will be held responsible for damage. If damage to equipment is the fault of the Contractor, he/she will have three (3) working days to make repairs to supply like items, at his/her expense, for damaged items. If the Contractor fails to repair or replace damaged items in said time, the City will charge the Contractor for the assessed value as determined by the City Engineer.

- 1.4.4 No existing signs, luminaires, luminaire mast arms, or luminaire support poles shall be removed by the contractor other than those specified in the plans. All signs, luminaires, luminaire mast arms, and luminaire support poles removed shall be returned to the city of Bryan.
- 1.5 The Contractor's responsibility for correcting any substandard workmanship and/or materials shall extend for a period of twenty-four (24) months from the date the signal installation is accepted by the City.
- 1.6 The locations of traffic signal support pole foundations, controllers, pedestal poles, conduit, ground boxes, etc., shown on these plans are approximate. The Contractor shall give the City Engineer 48 hours notice of his/her intention to establish the final location of any foundations, pedestal poles, conduit, etc., and have the locations staked on the ground by the City Engineer.
- 1.7 Although the plans are drawn approximately to scale, the positional relationship of some system components and equipment (e.g., cabinet and pole locations) have been distorted for purposes of clarity.
- 1.8 NO EXTRA COMPENSATION WILL BE GRANTED FOR FULFILLING THE REQUIREMENTS STATED ABOVE.

2.0 MATERIALS

- 2.1 <u>General Notes</u>
 - 2.1.1 It is the Contractor's responsibility to furnish all materials necessary to complete the traffic signal installation, whether the item is specifically mentioned or not. All unspecified materials (i.e., electrical tape, bolts, and nuts, etc.,) shall meet the requirements of the National Electrical Code. All materials supplied by the Contractor shall be new, undepreciated stock.
 - 2.1.2 Certain sections of these specifications list examples of acceptable brands and model numbers of the items described. Items of equal durability, performance, and design may be substituted upon acceptance by the City. Bidders are required to submit to the City Engineer information on all materials they desire to furnish and install. If the guidelines listed above are not met, the bid and the equipment shall not be accepted.
 - 2.1.3 If more than one unit of a given bid item is required, then the Contractor shall insure that all units are the product of one manufacturer, unless otherwise directed by the City Engineer.

- 2.1.4 All materials furnished by the Contractor shall become the property of the City of Bryan, effective upon successful completion of a thirty-day test period. The Contractor shall have full responsibility for the material until the date of acceptance with respect to damage, theft, or loss.
- 2.1.5 Prior to final acceptance by the City, the Contractor is responsible for removal, replacement, and reinstallation of any damaged material at the Contractor's expense.

2.2 <u>Traffic Signal Heads</u>

- 2.2.1 Each signal head shall be a weather tight assembly of one or more signal faces of the expansible, adjustable, LED type, together with all brackets and fittings necessary for proper mounting with the type of signal support designated on the plans. Each signal face shall consist of one or more signal sections, rigidly and securely fastened together, capable of being positively positioned to control the movement of one direction of traffic. Each signal section shall consist of an optical unit, housing, housing door, and visor. All signal heads on a project shall be the product of one manufacturer and conform to City standards and specifications provided in these documents.
- 2.2.2 The housing for each signal section shall be made of durable polycarbonate and shall be black in color. It shall be clean, smooth and free from flaws, cracks, blowholes, and other imperfections. It shall be designated as a self-contained unit capable of separate mounting or inclusion in a signal face containing two or more signal sections rigidly fastened and perfectly aligned together. It shall be equipped with round openings in the top and bottom so that it may be rotated between water-proof supporting brackets and thus be capable of being directed at any angle in the horizontal plane. It shall be equipped with positive locking devices to maintain a specific angle of direction when in place. The doors shall be black in color, and suitably hinged and held securely to the body of the housing by simple stainless steel locking devices. All other door parts, such as hinge pins, lens clips, screws, etc., shall also be of stainless steel material. Neoprene gasketing shall be used between the lenses and reflectors to exclude dust and moisture. The depth of each housing section shall not be greater than 7-1/8" for 12-inch signal heads. Each signal housing shall accept both plastic and aluminum backplates.
- 2.2.3 All visors shall be made of durable polycarbonate and shall form a tunnel visor. All visors shall be black in color, not less than 0.05 inches in thickness. Each visor shall be designed to fit tightly against the housing door. Visors shall be at least 9-1/2 inches deep for 12-inch signal sections, and have flat black finish on the inside surface. All visors supporting louvers shall be full circle and constructed of aluminum and have the same physical appearance as the polycarbonate visors.
- 2.2.4 The optical system for each signal section shall meet the following requirements:
 - a. The lens shall be a LED unit, manufactured by LEOTEK, as indicated below, designed for use in standard 12" traffic signal sections.
 - 1. All lenses shall be standard clear lenses, MG-Type 1 "A" lamps, 120 VAC Power.

- 2. Red Balls Model No. TSL-12R-MG-A1, AllnGaP LED Type, AC Power, 80-135 (VAC) input voltage.
- 3. Yellow Balls Model No. TSL-12Y-MG-A1, AllnGaP LED type, AC Power, 80-135 (VAC) input voltage.
- 4. Green Balls Model No. TSL-12G-MG-A1, InGaN LED Type, AC Power, 80-135 (VAC) input voltage.
- 5. Yellow Arrows Model No. TSL-12YA-MF-A1, AllnGaP LED Type, 3 LED Rows, 80-135 (VAC) input voltage.
- 6. Green Arrows Model No. TSL-12GA-MF-A1, InGaN LED Type, 3 LED Rows, 80-135 (VAC) input voltage.
- b. Reflectors shall be either aluminum or Alzak treated polycarbonate.
- c. Lamp sockets shall be standard pre-focused rotatable socket with lamp grip to permit positioning of the lamp filament for optimum output without the use of tools. Lamp sockets shall be provided with two color-coded leads and pronged terminals. The lead wires shall be #18 AWG, type THW, rated for a maximum of 600 volts, and capable of withstanding temperatures up to 110 degrees Centigrade. The lead wires shall have 1/32 inch thermoplastic insulation.

2.3 <u>Pedestrian Signal Heads</u>

Each pedestrian signal head must meet the following requirements:

- 2.3.1 The maximum dimensions of the signal head shall be:
 18 ¹/₂ inches wide
 18 3/4 inches high
 9 inches deep
- 2.3.2 The casing of the signal head shall be one piece polycarbonate or corrosion resistant aluminum alloy with four (4) integrally cast hinges to provide for operation of a swing open door and thumb screw locking device. The casing shall be black in color.
- 2.3.3 The entire signal head assembly shall form a dust and weather proof unit after installation.
- 2.3.4 Each signal head shall be compatible with the mounting hardware as stated in these specifications.
- 2.3.5 The optical unit shall include 14" Dual LED lens, Manufactured by LEOTEK, Model No. TP14D-HM-XXX, Portland Orange/White, AllnGaP & InGaN LED Type, 80-135 (VAC) input voltage, designed to display a uniform, bright alternate International Symbol Hand & Walking Man.
- 2.3.6 Each pedestrian head shall include a 1-1/2" deep polycarbonate eggcrate visor with impregnated flat back color, designed to eliminate the interference of sunlight and to allow clear visibility of the messages.
- 2.3.7 Each pedestrian signal door shall be designed with adequate hinges and latch slots to provide swing open door operation and thumb screw locking devices.

- 2.3.8 All associated pins, screws, bolts, and nuts shall be made of stainless steel material to resist corrosion.
- 2.3.9 Pedestrian signal heads shall satisfy the requirements of the specifications contained in these documents.

2.4 Traffic and Pedestrian Signal Head Mounting Hardware

Each mounting hardware assembly shall be a universally adjustable signal bracket, meeting the following requirements listed below.

- 2.4.1 The bracket shall allow for traffic or pedestrian signal head rotation about the bracket axis, rotation about the supporting member axis, rotation on the vertical plane, and sliding of the support tube against the bracket connection point on the supporting member.
- 2.4.2 The bracket shall be attached to the supporting member with a stainless steel band or cable capable of withstanding 100 KSI tensile stress.
- 2.4.3 The bracket attachment to the signal head shall assume rigid connection through the top and the bottom of the signal head.
- 2.4.4 The bracket shall be of the type to accept the number of signal sections specified in the plans for each signal head, (i.e., one-way brackets shall be provided for a single pedestrian head and two-way brackets for two pedestrian heads).
- 2.4.5 The entire assembly shall be capable of securely supporting a signal head under 80 mph wind loading conditions on the attached member.
- 2.4.6 All parts used in this assembly shall be made of corrosion resistant material or be coated with a corrosion resistant finish.
- 2.4.7 Each bracket shall be furnished with the necessary hardware for installation on the signal supporting member.
- 2.4.8 When two-way mounting brackets are used, the design (arm lengths, the distance between the upper and lower arms, and the angle between the two-way arms) shall be such as to allow complete rotation of the pedestrian signal heads about their vertical axis.
- 2.4.9 All pedestrian signals shall be furnished with the specified mounting hardware installed and completely wired to the signal head, suitable for mounting on the specified side of the pole. The casing shall include top and bottom openings that are sealed with removable plugs and that are intended for use with 1-1/2 inch pipe bracket mounting hardware.
- 2.4.10 Other brands of traffic and pedestrian signal mounting hardware, installed and completely wired to the signal head, shall be suitable for mounting on the specified side of the pole. The casing shall include top and bottom openings that are sealed with removable plugs and that are intended for use with 1-1/2 inch pipe bracket mounting hardware.

2.5 <u>Pedestrian Pushbutton Assemblies</u>

- 2.5.1 The assembly shall be one piece cast aluminum construction which includes a pushbutton switch with an "ADA" 2-inch die cast aluminum button, sign frame, and sign.
- 2.5.2 The housing of the pushbutton switch shall be completely dust and moisture resistant.
- 2.5.3 The sign frame for each assembly shall accept a minimum 5" x 7" sign.
- 2.5.4 The sign shall have a white reflective background with black lettering and border meeting graphical and textural requirements as specified on the plans.
- 2.5.5 Curved back assemblies shall be provided for mounting on round poles of 4 to 15 inches in diameter.
- 2.5.6 The pushbutton housing and sign shall have a federal yellow, corrosion resistant finish.
- 2.5.7 All signs shall have black directional arrows, indicating direction of movement associated with the pushbuttons, and conform to the PUSH BUTTON FOR GREEN LIGHT Sign (R10-3b) contained in the TMUTCD.

2.6 <u>Backboards</u>

2.6.1 Aluminum backboards, black in color, shall be installed behind each signal head, and positioned such that the signal head is "centered" on the backboard.

2.7 <u>Ground Box Type</u>

2.7.1 General Requirements

All ground boxes specified for use at signalized intersections shall satisfy the following requirements:

- a. The top surface of the ground box cover shall have a minimum co-efficient of friction of 0.5.
- b. Boxes shall be stackable for extra height.
- c. The logo "TRAFFIC SIGNAL" shall be imprinted as an integral part of all ground box covers.
- d. All ground box covers shall be furnished with a locking mechanism to prevent access to the ground box without the use of tools.
- e. Enclosures and covers shall be rated for a minimum of 5000 lbs. strength over a 10" x 10" area. All components shall be designed and tested to withstand temperatures as low as -20 degrees F.
- 2.7.2 Ground Boxes

Ground boxes used shall be either Type B Ground Box $(11.5" \times 21" \times 20")$ or Type D Ground Box $(15.25" \times 28.21" \times 20")$, as per TxDOT specifications. Smaller ground boxes may be used to accommodate conduits containing single or a minimal number of wires (like power cable).

Ground boxes shall meet the following requirements in addition to the general requirements for ground boxes:

- a. All ground boxes shall meet the requirements for incidental traffic (H-10) loading as prescribed by the American Association of Highway and Transportation Officials. Boxes shall be tested using the AASHTO prescribed load of 8000 lbs. per axle for H-10 loading.
- b. Ground boxes shall be tested for side loads of 600 psf as generated by traffic load or soil compaction during installation.
- c. The material used for production of ground boxes shall consist of light polymer concrete for portions of the box under compression stress, and fiber reinforced polymer for portions under tension stress.
- d. Boxes shall be labeled "Danger-High Voltage Traffic Signal."
- e. All ground boxes shall have concrete aprons.

2.8 <u>Traffic Signal Structure and Luminaire Support Poles</u>

All traffic signal structure poles, signal mast arms, luminaire support poles and luminaire supports shall meet the specifications contained in these documents. Luminaires shall be 200 watt, high pressure sodium.

2.9 <u>Controller and Signal Pole Foundations</u>

2.9.1 All foundations shall be built in accordance with the requirements stated in the foundation drawing section of the standard detail sheet. Contractor is responsible for all material required to construct foundations. As shown in the plans detail sheet specifications, the size and depth of signal pole foundations vary according to the length of the mast arm on the signal pole.

2.10 <u>Controller and Controller Components</u>

2.10.1 The City shall furnish eight-phase traffic signal controllers complying with current NEMA specifications and compatible with the existing city signal system, complete with cabinet, solid state flasher, conflict monitors, amplifiers, solid state load switches, solid state loop detector modifiers, pictorial layout of components and all other related components as described in the Bid Proposal.

2.11 <u>Meter Pedestal Poles</u>

The Contractor shall supply and install a 125-amp, 4-Terminal, Meter Pedestal Pole where specified. Contractor is responsible for selecting a meter pedestal pole approved by the city of Bryan and installing meter pedestal pole as indicated in the plans detail sheet. City shall provide power to the meter pedestal pole. Contractor shall install all necessary wiring from meter pedestal pole to the signal installation hardware, and install conduit to power source as shown in the plans.

2.12 Confirmation Lights

2.12.1 Contractor shall obtain traffic signal confirmation lights and all necessary attaching hardware and wiring, and install confirmation lights on all signal poles.

- 2.12.2 Confirmation lights shall be obtained from Pelco Products, Inc., Part No. SM-0287-L (Traffic Signal Confirmation Light Assembly, w/Astro-Mini-Brac and clear globe).
- 2.12.3 Confirmation lights shall be installed on signal poles adjacent to mast arm as shown on plans and detail sheets. Light shall be illuminated when "red" signal indications are illuminated on signal heads attached to same mast arm.
- 2.13 Priority Control System Detectors
 - 2.13.1 Contractor shall provide 3M Opticom Priority Control System detectors (Model 711) and Model 739 detector wiring where specified.
 - 2.13.2 Contractor shall install detectors on signal pole mast arms, as indicated in plans and detail sheets, and install wiring from detectors to controller.
- 2.14 Conduits and Related Hardware
 - 2.14.1 <u>PVC Conduits</u> All polyvinyl chloride conduits, including elbows and couplings shall be Schedule 40 gray, PVC conduit, conforming to Federal Specification W-C-1094 and Underwriters' Laboratories, Inc. Standard UL-651. All conduit sizes shall be as indicated on the plans.
 - 2.14.2 Weatherheads shall be of aluminum and threaded to conduit.
- 2.15 <u>Multi-conductor Cable</u>
 - 2.15.1 All cable for intersection signalization shall be multi-conductor capable of operating at 600 volts maximum, and suitable for use at conductor temperatures not exceeding 75 degrees Centigrade (167 degrees F).
 - 2.15.2 Conductors shall be stranded IMSA 19-1, #14 AWG copper wire. The copper wire (before insulating) shall meet requirements of the latest American Society for Testing Materials' (ASTM) standards for uncoated wire.
 - 2.15.3 Where practical, color codes shall be followed so that the red insulated conductor connects to the red signal indication terminal, yellow to yellow, and green to green. This color code shall be followed throughout the cable run, not just at the points of termination.

2.16 <u>Power Lead-in Cable</u>

- 2.16.1 Power lead-in cable shall be stranded THW copper wire and suitable for AC service.
- 2.16.2 The cable shall be capable of operating at 600 volts maximum and suitable for use at conductor temperatures not exceeding 75 degrees C. Material and construction shall be in accordance with the applicable requirements of IMSA standards.
- 2.16.3 Conductors shall be stranded, anneal coated copper. Copper wire, before insulating or stranding, shall meet the requirements of the latest edition of ASTM

B-033 (for coated wire). Stranding shall be class B, in accordance with the latest edition of ASTM B-8.

2.16.4 Insulation shall consist of cross-linked thermosetting polyethylene, meeting the requirements of IMSA and listed by UL as type USE RHW-75C.

2.17 <u>Pedestal Pole</u>

Contractor shall install aluminum pedestal pole as shown in the plans. The foundation for the pedestal poles shall be constructed as shown in the details sheet in the plans.

2.18 Video Camera Detection System

The Contractor shall obtain all devices necessary to install video camera detection devices at the intersections to be signalized, as shown in the plans. All devices shall be obtained from Texas Highway Products Corporation, P. O. Box 928, Round Rock, Texas 78680. (Telephone Number is 512/255-7633.)

- 2.18.1 A video camera (Iteris Vantage Model RZ3) shall be installed on each approach at an intersection. The camera shall be mounted (with Iteris Universal Camera Mounting Bracket, CAMBRKT4) on the signal mast arm facing the approach. The camera shall be mounted at least five (5) feet above the mast arm using the PELCO "Astro-Brac" 74-inch Camera Extension Bracket.
- 2.18.2 Each intersection shall have an Iteris Edge II Processor (dual-Texas, 4-video input) installed in the controller cabinet.
- 2.18.3 Each intersection shall have a 9" monitor (Model GV-MB90) installed in the controller cabinet.
- 2.18.4 Video cable (75 ohm precision) (Part Number Beldon 8281) and 3 conductor 16 gauge cable (Carolprene Jacketed Type 5JOW, Catalog No. 01342) shall be used to connect the video cameras to the VTDS Processor and monitor.
- 2.19 Dampers

Contractor shall supply and install dampers on all signal mast arms 40 feet in length or longer. The damper shall consist of a 12" by 36" aluminum sign blank. The damper shall be installed on the mast arm at the end of the arm furthest from the support pole. the damper shall be mounted so that the 36"-dimension is parallel with the pole, and that the surface of the blank lies on top of the mast arm and parallel with the ground below. The mounting procedure shall be determined by the Contractor but shall satisfy the City Engineer.

3.0 INSTALLATION OF TRAFFIC SIGNAL COMPONENTS

- 3.1 Installation of Electrical Service
 - 3.1.1 The Contractor shall coordinate the installation of electrical service with Bryan Texas Utilities.
 - 3.1.2 The power supplied to the controller cabinet shall be 115-125 volt, single-phase, 60 cycle AC. The wire used for power connection shall be insulated for six

hundred (600) volts. The common wire shall be white-coded and the power positive shall be black-coded.

3.1.3 The City shall provide electrical service to the meter pedestal pole. The Contractor is responsible for providing and extending power cable from the meter pedestal pole to the controller. The Contractor also is required to install conduit from the meter pedestal pole to the power source, as shown in the plans.

3.2 Installation of Conduit

3.2.1 The Contractor shall provide and install underground cable facilities required to satisfy the requirements of the signal project proposed. Cable routing will be through conduits installed by the Contractor as shown in the plans. The Contractor shall be responsible for detailed coordination of proposed cable routing and actual installation with the City before any work is started.

3.2.2 <u>New Conduit</u>

- a. Unless otherwise shown on the plans or standard detail sheets, all conductors shall be placed in schedule 40 PVC conduit except when in metal poles. All conduit and fittings shall be of the sizes and types shown on the plans. Each section of conduit shall bear evidence of approval by Underwriter's Laboratories.
- b. Conduit terminating in posts or pedestal bases shall not extend vertically more than 3 inches above the concrete foundation. Field bends of conduit shall have a minimum radius of 12 diameters of the nominal size of conduit.
- c. PVC conduit shall be joined by the solvent-weld method in accordance with the conduit manufacturer's recommendations. No reducer couplings shall be used unless specifically indicated on the plans.
- d. All conduit and fittings shall have burrs and rough places smoothed and shall be clean and free of obstructions before cable is installed. Field cuts shall be made with a hacksaw only, and shall be square and true so that the ends will butt or come together for the full diameter thereof. In no case shall a cutting torch be used to cut or join conduit. When a standard coupling cannot be used, an approved union coupling shall be used and shall provide a water-tight coupling between the conduits. All couplings shall be properly installed to bring their ends of connected conduit together to produce a good rigid connection throughout the entire length of the conduit run. Ends of conduit shall be capped or plugged until installation of wire is complete. Conduits shall be placed in an open trench at a minimum 24 inches depth below the curb grade in the sidewalk areas, or 24 inches below the finished street grade in the street areas. Where specified in plans, conduits shall be installed at greater depths.
- e. Conduit placed for concrete encasement shall be secured and supported in such a manner that the alignment will not be disturbed during placement of concrete. No concrete shall be placed until all of the conduit ends have been capped and all box openings closed.

- f. Where specified in the plans for cutting existing pavement, the Contractor shall coordinate conduit placement activities with the City Engineer before beginning work.
- g. Backfill Compaction & Density Test for All Ditchlines: All ditchlines within paving areas and within two feet back of curb are to be mechanically tamped. All tamping is to be density controlled to 90% standard proctor density at optimum moisture content and no greater than 5% optimum or less than 2% below optimum. All backfill material is to be select native material, 6" diameter clods and smaller. It is permissible to put backfill in 6"-8" lifts with densities being taken for each 1' of compacted material on offsetting stations of 50'.
- h. The Contractor shall provide adequately bent conduit and shall properly excavate so as to prevent damage to the conduit or conductor by a bend radius which is too short.
- i. All conduit runs shall be continuous and of the same material (metal only or PVC only). Where tying into existing conduit, the Contractor must continue with the same material (metal to metal or PVC to PVC).

3.3 Installation of Cable

3.3.1 General

- a. Conduit must be continuous, reasonably dry, completely free of debris, and without sharp projections, edges or short bends. The conductors shall be installed in a manner so as to insure against harmful stretching of the conductors or damage to the insulation. Installation methods shall conform to the recommendations of the cable manufacturer. The Contractor shall furnish, at the request of the City Engineer, at least two copies of the manufacturer's recommendations, which shall include methods of attaching pull cable, pulling tension per conductor size and per radius of conduit bend, and the type of lubricant to be used.
- b. All cables in a given conduit run shall be pulled at the same time and the conductors shall be assembled to form one loop in such a manner that the pulling tension is equally distributed to all the cables. Long, hard pulls will necessitate the use of pulling eyes. For short runs, the cables may be gripped directly by the conductors by forming them into a loop to which the pull wire or rope can be attached. The insulation on each conductor shall be removed before the loop is formed. The method used will depend on the anticipated maximum pulling tension in each case.
- c. Where existing conduits are to be used, existing signal cables may be used for the installation of new cables. At locations where new cables are to be added to existing cable runs, the existing cables may be pulled out, then replaced, adding the new cables to the existing cables to form one cable pull. Installation and removal shall be done in such a way as to prevent damage to the existing and/or new cables. In the event of damage, the Contractor shall bear the responsibility of providing the material and labor for replacement of defective cables at no extra cost to the City.
- d. All conduit runs shall be measured accurately and precisely for determining cable lengths to be installed. The Contractor shall record all cable measurements and include the distances on an as-built drawing.
- The manufacturer's recommended maximum pulling tensions shall not be e. exceeded under any circumstances. If so required by the City Engineer, the Contractor shall insert a dynamometer in the pull wire as the cables are being pulled into the conduit to demonstrate that the maximum tensions are not being exceeded. The cable shall be fed freely off the reel into the conduit without making a reverse curve. At the pulling end, the pull wire and cables shall be drawn from the conduit in direct line with the conduit. Sheaves or other suitable devices shall be used as required to reduce any hazards to the cable during installation. The cables shall be adequately lubricated to reduce friction and further minimize possible damage. Such lubrications shall not be the grease or oil type used on lead sheathed cables, but shall be one of several commercially available wire pulling compounds that are suitable for PVC sheathed cables. They shall consist of soap, talc, mica, or similar materials and shall be designed to have no deleterious effect on the cables being used.

- f. Cables shall be neatly trained to their destinations. The Contractor shall adhere to the manufacturer's recommended values for the minimum bending radii to which cables may be bent for permanent training during installation. These limits do not apply to conduit bends, sheaves, or other curved surfaces around which these cables may be pulled under tension while being installed. Larger radius bends are required for such conditions.
- g. Duct seal putty shall be packed around cables at the end of each conduit run to seal the conduit openings and prevent moisture and debris from entering.

3.3.2 Wire and Cable

a. All wire and cable shall conform to the requirements shown on the plans, except wire and cable specifically covered by other items of this contract.

3.3.3 Controller Cabinet Wiring

- a. Wiring for the controller cabinet shall consist of connecting (1) signal wires, (2) power wires, (3) ground wires, (4) pedestrian pushbutton wires, (5) confirmation lights wires (6) video cable, and (7) priority control system cable. In the controller cabinet, stranded signal conductors from the field shall be stripped back and a solderless terminal connector shall be attached by means of a compression crimp insulated ring lug. These terminal connectors shall be inserted under the binder head screw and tightened securely. Other wiring for the controller shall be completed as shown on the wiring diagrams and in the instructions furnished with the controller by the manufacturer.
- b. All field wiring in cabinets shall be neatly installed. Incoming cables shall be trained to their destination and neatly laced together. All spare wires shall be trimmed and neatly coiled with their ends taped.
- c. Pedestrian pushbuttons shall have a logic ground wire that is completely isolated and independent from all other ground wires. This wire shall be connected to the designated terminal in the controller cabinet.

3.3.4 Signal Head Wiring

a. The Contractor shall wire all signal heads with adequate wire to tie each head into the signal cable for the system. Wiring for the signal head shall consist of connecting the terminal block in each signal section to the common terminal block in each signal face, and where applicable, connecting the common terminal block in each signal face to the terminal block in the signal-head terminal compartment. For mast arm and pole mounted heads, all conductors running from the pole's terminal compartment or transformer base to the signal head terminal shall be #14 AWG stranded.

3.3.5 <u>Terminals</u>

a. The ends of all stranded wires which are to be attached to terminal posts shall be provided with solderless terminal connectors, attached as specified in Section 3.3.3a.

3.3.6 Splices

- a. Splices are prohibited, unless approved by City Engineer.
- b. Terminal blocks shall be utilized where possible when terminating signal cables in signal pole bases.
- c. Splicing methods shall be in accordance with good electrical practice and the cable manufacturer's recommendations. All materials used shall be of high quality and specifically intended for this purpose. Cables shall be trained to their final position and cut to proper lengths. The cable's jacket and insulation shall be removed as required. In doing this, use proper care to insure against nicking the conductors. The connection shall be installed tightly and all burrs, rough edges, etc. shall be removed.
- d. Splices in communication cables shall include the shield. Splices between cables pairs shall be made with "Scotchlock" solderless connectors designed for this purpose. The completed splice shall be insulated with a 3M Scotch cast kit. Splices at points other than those shown on the plans or variances from the splicing procedures outlines above may be made only with the written permission of the City Engineer.
- e. The City Engineer shall select at random at least three (3) splices to be thoroughly inspected. The Contractor shall, in the presence of the City Engineer, sectionalize each selected splice to expose the various layers of materials and the connector. These splices shall be thoroughly checked for compliance to these special provisions. Each splice shall then be remade by the Contractor. This work shall not require extra payment, but is subsidiary to other items in then Contract. All of the splices selected for this inspection shall conform to the requirements of these special provisions. If any splices fail to meet these requirements, then three (3) more splices shall be selected at random by the City Engineer for examination.

3.3.7 Enclosed Wiring

a. Except for cables suspended by span wire and electrical wiring within steel signal poles, all cables and conductor wire above the ground surface shall be enclosed in metal conduit up to but not closer than one foot below the lowest power conductor source. Power-tap lines carried down poles shall be placed in metal conduit.

3.3.8 Identification of Signal Wires and Cables

- a. IMSA color coded signal cable shall be used for all signal systems. Colors shall be continuous from point of origin to point of termination. Splices will be permitted only if the same colors are spliced.
- b. Each signal cable, detector lead-in cable and communication cable shall be designated with permanent marking labels at each ground box and in the controller cabinet.

3.4 <u>Grounding</u>

3.4.1 There shall be a properly installed and connected ground rod for each controller cabinet to reduce any extraneous voltage to a safe level. All ground rods shall be supplied by the contractor. The ground rod shall be located so as to minimize the length of the grounding-conductor run. All grounding circuits shall be substantial and permanent and shall be electrically continuous with an ohms-to-ground resistance not to exceed 10 ohms when tested by a volt-ohm-meter.

3.4.2 Grounding Connectors and Electrodes

The grounding conductor shall be a No. 6 AWG stranded copper wire. The conductor shall be bonded to ground rods. Ground rod electrodes shall be copperclad steel being at least 5/8 inch in diameter and shall be driven into the ground to a depth sufficient to provide the required resistance between electrodes and ground (10 ohms). All ground rods shall be a minimum of eight (8) feet long. Connections to underground metallic conduit shall be considered sufficient for grounding requirements. Connection of grounding circuits to grounding electrodes shall be by devices which will ensure a positive, fail-safe grip between the conductor and the electrode (such as lugs or pressure connectors). No splice joint will be permitted in the grounding conductor.

3.5 Concrete Foundations for Signal and Luminaire Support Structures

- 3.5.1 All foundations shall be staked by the Contractor and approved by the City Engineer prior to excavation.
- 3.5.2 The Contractor shall probe before excavating foundations to determine the location of utilities and structures. Foundations shall be paid for once, regardless of extra work caused by obstructions. The Contractor shall furnish all supplementary items necessary for proper foundation installation.
- 3.5.3 Excavation for all foundations shall be done in accordance with lines and depths indicated on the plans. All loose material shall be removed from the excavation before concrete is placed. Any water shall be removed by pumping or bailing. The use of explosives will <u>not</u> be permitted.
- 3.5.4 Foundations shall be constructed to the dimensions shown on the plans or as directed by the City Engineer. The Contractor is required to make certain that the top of the finished foundation is level and formed and shall not extend more than two inches above ground level, unless additional height is required for proper signal head heights. Anchor bolts and conduits shall be held rigidly in

place by a template until the concrete is set. A mechanical vibrator shall be used for compacting and working the concrete.

- 3.5.5 Backfill shall be tamped with mechanical tamps in 6 inch layers to the density of the surrounding ground. Where excavation is made in the roadway shoulder, the shoulder shall be replaced with material equal to original compensation.
- 3.5.6 All excavated material, not required for backfill, shall be removed and disposed of by the Contractor, outside the limits of the project. The work shall be kept clean and neat at all times.
- 3.5.7 No concrete shall be placed when the atmospheric temperature drops below 40 degrees F (temperature reading to be taken in the shade away from artificial heat) unless permission to do so is given by the City Engineer.
- 3.5.8 City reserves the right to test concrete (break test). Contractor shall be required to pay for any tests deemed appropriate by the City.
- 3.5.9 Concrete shall be used on this project must satisfy requirements of the Bryan/College Station Unified Design Manual.
- 3.6 Installation of Traffic Signal and Luminaire Support Structures
 - 3.6.1 The Contractor shall provide a complete traffic signal structure location plan/schedule showing the location of all conduits and foundations. This plan shall be approved by the City Engineer before any structure is installed.
 - 3.6.2 The Contractor shall examine foundations, which are to support traffic signal and luminaire support poles, to assure proper anchorage alignment. Any discrepancies shall be reported to the City Engineer.
 - 3.6.3 If shims are required for leveling, total shim height shall not exceed ¹/₂ inch. Foundation anchor bolts shall extend a minimum of one inch (1") through each nut in the base.
 - 3.6.4 Except as modified herein, erection of traffic signal and luminaire support structures shall be in accordance with the applicable specifications and standards of the AISC Manual of Steel Construction. Erecting equipment shall be suitable for the work and shall be in first class condition. Where parts cannot be assembled or fitted properly as a result of errors in fabrication or deformation due to handling or transportation, such condition shall be reported immediately to the City Engineer for approval of the method of correction that shall be used. Straightening of plates and angles or other shapes shall be done by approved methods.
 - 3.6.5 Bearing surfaces and surfaces which will be in permanent contact with each other shall be cleaned before the members are assembled. Bearing plates shall be set in exact position and shall have a full and even bearing upon the concrete.
 - 3.6.6 Bolted parts shall fit solidly together when assembled and shall not be separated by gaskets or any other interposed compressible material. When assembled, all joint surfaces, including those adjacent to the bolt heads, nuts, or washers, shall

be free of scale, except tight mill scale, and shall also be free of burrs, dirt, and other foreign material that would prevent the solid seating of the parts. Each fastener shall be tightened to provide, when all fasteners in the joint are tight, at least the minimum bolt tension shown in Table 3 of the AASHTO Streetscape Structure Specifications for Structural Joints using ASTM A325 or A490 bolts for the size of fastener used. Threaded bolts shall be tightened with properly calibrated wrench method (or by torque control) shall have a hardened washer under the element (nut or bolt head) turned in a point not closer than 7/8 of the bolt diameter from the center of the washer. Calibrated wrench tightening and "turn-of-nut" tightening shall conform to the AASHTO Specifications for Structural Joints using ASTM A325 or A490 bolts.

- 3.6.7 Contractor shall use extra caution when transporting and installing poles, signal mast arms, and luminaire supports to protect the finished surface material texture and color. Only web slings shall be used to hoist the poles and mast arms.
- 3.7 <u>Grouting</u>

The Contractor shall perform all work required to complete the grout work associated with installing the signal structure and furnish all supplementary items necessary for its proper installation. A waterproof silicone-based sealer between the controller cabinet and controller foundation is required.

- 3.8 Installation of Signal Heads
 - 3.8.1 The Contractor shall be required to assemble all signal head units as specified in the plans or as directed by the City Engineer. The Contractor shall mount signal heads level and plumb. The Contractor shall position and secure the signal heads so they are visible as stipulated on page 4D-14, Table 4D-1 of the 2006 edition of the Texas Manual on Uniform Traffic Control Devices.
 - 3.8.2 All signal heads or parts of head not in operation shall be turned downward or bagged until placed into operation.
 - 3.8.3 All hardware in each signal head assembly shall be completely tight. Signal and pedestrian heads shall be securely tightened immediately after the signal head has been installed. If any signal head assembly is found to be loose or asymmetrical in any manner, the Contractor shall be required to remove and rebuild the signal head assembly to the satisfaction of the City Engineer.
 - 3.8.4 No painting will be required for the signal heads except those parts on which the paint has been scratched or marred, and such parts shall be given two coats of high-grade enamel or paint of the same color as the factory paint.

3.9 Controller Cabinet Preparation

- 3.9.1 The Contractor shall be responsible for transporting the controller cabinet to the project site and for mounting the controller cabinet to the controller foundation.
- 3.9.2 All wiring modifications made in conjunction with preparing the cabinet for use at a specified intersection shall be documented on the cabinet prints for that intersection.

4.0 PRESERVATION OF LANDSCAPING, SPRINKLER SYSTEMS, AND OTHER PRIVATE PROPERTY

- 4.1 The Contractor shall assume full responsibility for the preservation of existing landscaping (sod, shrubbery, trees, and etc.), sprinkler systems, and other private property at the site during the installation of items in this contract document. Damaged landscaping, sprinkler systems, and other private property shall be replaced within a reasonable time, by the Contractor at his own expense, to the satisfaction of the City Engineer.
- 4.2 No trees or shrubbery shall be cut except on the specific authority of the City Engineer.
- 4.3 Contractor is responsible for replacing or placing new grass sod over trenched area.

5.0 REMOVAL OF MISCELLANEOUS ITEMS

- 5.1 <u>Removal and Replacement of Curbs, Inlaid Bricks, and Sidewalks</u>
 - 5.1.1 The Contractor shall secure permission from the proper authority and the approval of the City Engineer before cutting into or removing any curbs, inlaid bricks, or sidewalks which might be required during construction.
 - 5.1.2 Where possible, dig under sidewalks. If the Contractor chooses to remove or cut the sidewalk, the concrete must be sawed and broken out and then restored to an equal or better condition than the original.
 - 5.1.3 After work is complete, the Contractor shall restore any curbs, inlaid bricks, or sidewalks which have been removed to the equivalent of, or better than, their original condition and to the satisfaction of the City Engineer.

6.0 SAMPLING AND TESTING

- 6.1 <u>General Notes</u>
 - 6.1.1 The failure of the City to make any tests of the materials shall in no way relieve the Contractor of his responsibility of furnishing materials conforming to the specifications.
 - 6.1.2 Tests, unless otherwise specified, shall be made in accordance with the latest methods of the ASTM or other approved test methods. The Contractor shall provide such facilities, as the City Engineer may require, for the collecting and forwarding of samples and shall not use the materials represented by the samples until tests have been made. The Contractor shall furnish adequate samples without charge.
- 6.2 <u>Concrete</u>
 - 6.2.1 All concrete materials, reinforcing steel, and preparation shall be in accordance with the requirements of the Bryan/College Station Unified Design Manual, Technical Specifications, and Standard Construction Details, and with the specifications contained in these documents.

6.3 Signal Cables

- 6.3.1 All cables shall be checked for insulation resistance upon installation and prior to termination. The test shall be made with a test set operating at a minimum of 600 volts DC applied to the conductors.
- 6.3.2 Each conductor in the multi-conductor signal cables shall be tested for insulation resistance relative to each other and to ground. The minimum acceptable value for insulation resistance shall be one (1) megohm.

6.4 <u>Controller Cabinets</u>

6.4.1 The City of Bryan shall be responsible for completing any and all tests required to ensure proper operation of the controller cabinet supplied to the contractor.

7.0 WARRANTIES/GUARANTEES

- 7.1 The Contractor guarantees all work performed and materials furnished by the Contractor under this project for a period of twenty-four (24) months following the date of final acceptance. In addition, the Contractor shall furnish any normal manufacturer warranties with effective beginning dates the same as the date of the project acceptance.
- 7.2 All faulty equipment shall be repaired within 15 working days of the Contractor being notified.

8.0 TRAFFIC SIGNAL MAINTENANCE DURING CONSTRUCTION

- 8.1 While performing work under this contract, the Contractor bears the sole risk of loss for damages to or destruction of any traffic signal equipment or appurtenances, on equipment that was not to be replaced or installed under this Contract, but which was damaged or destroyed through the fault or negligent acts of the Contractor. The Contractor shall replace such damaged or destroyed equipment at no cost to the City, regardless of whether or not the damaged or destroyed equipment was a part of this contract or any warranties under this contract. The Contractor's responsibility shall cease under this paragraph on written acceptance of the intersection by the City.
- 8.2 The Contractor shall utilize qualified personnel to respond to all traffic calls and to repair any malfunctions. A local telephone number (not subject to frequent changes) where trouble calls are to be received on a 24-hour basis shall be provided to the City Engineer by the Contractor. The Contractor's response to reported trouble calls shall be within a reasonable travel time of not more than one (1) hour maximum. Appropriate repairs shall be made within twelve (12) hours.
- 8.3 It is recognized that the City may continue to make a first response to any trouble call. Action on such response will, however, be limited to placing the intersection on flash, replacing load switches or loop amplifiers, erecting temporary control devices, requesting immediate traffic control by uniformed police officer, or other such action deemed necessary to provide safe operation. Such action will in no way relieve the Contractor of his operation and maintenance responsibility.

9.0 SIGNS AND BARRICADES

- 9.1 The Contractor shall provide and maintain all necessary signs and other warning devices and take all precautionary measures required by law to protect persons and property while said persons or property are approaching, leaving, or within the work site or within any area adjacent to said work site. No separate compensation will be paid to the Contractor for the installation or maintenance of any warning devices, barricades, lights, signs, or any other precautionary measures required by law for the protection of persons or property, including off-duty police officers.
- 9.2 Contractor shall not remove any **permanent** signs currently in place within or near the project sites except as designated in the plans. The Contractor will be responsible for providing R10-12 "Left-Turn Yield on Green Ball" (24" x 30") signs to be installed on the signal mast arms, as indicated on the plans.
- 9.3 The Contractor shall assume all duties owed by the City to the general public's immediate approach to and travel through the work site and the area adjacent to said work site.
- 9.4 Where work takes place in, or adjacent to, any street, alley, sidewalk, public right-of-way or public place, the Contractor shall, at his own expense and when authorized by the City, provide flagmen and watchmen and shall furnish, erect, and maintain such warning devices, barricades, lights, signs, and other precautionary measures until the project has been accepted by the City.
- 9.5 If the City Engineer discovers that the Contractor has failed to comply with applicable federal and state laws (by failing to furnish the necessary flagmen, warning devices, barricades, lights, signs, or other precautionary measures for the protection of persons or property), the City Engineer may order such additional precautionary measures be taken to protect persons and property. The Contractor shall reimburse the City for any expenses incurred in order in taking such additional precautionary measures.
- 9.6 In addition, the Contractor shall be held responsible for all damages to work items and other public or private property due to the failure of warning devices, barricades, signs, lights, or other precautionary measures in protecting said property. Whenever evidence is found of such damage, the City Engineer may order the damaged portion immediately removed and replaced by the Contractor at his expense.

10.0 AS-BUILT DRAWINGS

10.1 The City shall furnish two (2) sets of plans to the Contractor at the time of construction. The plans shall be stored on AutoCAD-Version 14.0 (or most recent version) diskette. These plans shall be marked-up by the Contractor, throughout the construction period, indicating all changes, revisions, and additions to the work, including field relocations of work concealed from view and conductor cable lengths. On completion of the work at the intersection(s), the Contractor shall deliver these as- built drawings to the City Engineer. Delivery shall take place within ten (10) working days after the turn-on/cut-over date. The City reserves the right to delay signal turn-ons until delivery of as-built drawings is brought up-to-date.

11.0 PAYMENT FOR FURNISHING AND INSTALLING CONTRACT ITEMS

11.1 The unit bid price shall be full compensation for placing and testing all materials as well as use of equipment, tools, labor and incidentals necessary to complete the work. Portions of the work that have not been approved by the City Engineer will not be considered complete and payment shall be withheld until the Contractor has completed the work to the satisfaction of the City Engineer.

11.2 Payment for modifications to the controller cabinet for specific intersection use will be made after the signal turn-on.

12.0 EXPERIENCE AND QUALIFICATIONS

- 12.1 A list of cities, towns, counties, etc., where the contractor has constructed traffic signal installations shall be furnished to the City of Bryan for reference. This list shall contain names and phone numbers of persons who can be contacted for such reference.
- 12.2 The Bidder shall also furnish information, as outlines above, on each major subcontractor (if any) that will participate in this project. The City reserves the right to reject any and all subcontractors.
- 12.3 The City reserves the right to reject any and all bids and to waive formalities.