Traffic Signal & Streetlight Specifications

PREFACE

In these Specifications and other Contract Documents, the following abbreviations and acronyms shall be interpreted as follows:

- • AASHTO - American Association of State Highway and Transportation Officials
- • ASTM - American Society for Testing and Materials
- • ANSI - American National Standards Institute
- • IMSA - International Municipal Signal Association
- • ITE - Institute of Transportation Engineers
- • MUTCD -*Manual on Uniform Traffic Control Devices*
- • N.E.C. - National Electrical Code
- • N.E.S.C. - National Electrical Safety Code
- • Rules - Rules for Overhead Electrical Line Construction

  Utilities Commission

- • WAPM - *Work Area Protection Manual*

NOTICE

Requirements for all Traffic Signal Construction Projects and roadway construction projects requiring traffic signal modifications or installations.

1. IMSA Level II Traffic Signal Bench Technician/Signal Technician certification (BB certification) for any work within the traffic signal cabinet. This includes corrective maintenance and signal turn-on. As main contractor Conflow Power shall produce copies of certificates at the pre-construction meeting.
2. IMSA Level II Traffic Signal Field Technician/Electrician (BE certification) or Traffic Signal Bench Technician/Signal Technician Certification (BB Certification) for any work external to the traffic signal cabinet. An IMSA Level II Traffic Signal Electrician (minimum BE certification) must be the job-site at all times to supervise construction.
3. The United States Department of Labor – Bureau of Apprenticeship and Training can be substituted for the IMSA Level II Traffic Signal Electrician. Conflow Power shall produce copies of certificates at the pre-construction meeting.

Table of Contents

Table of Contents (Continued)

Table of Contents (Continued)

SECTION 12: STREETLIGHT DESIGN GUIDELINES.....112

vi

List of Traffic Signal Details

1. TS4-1.1 Controller Cabinet Foundation Details
2. TS4-1.2 Controller Cabinet Foundation Details

2. TS4-2 Mast Arm & Strain Pole Foundation Details
3. TS4-3 Pedestrian Pole Foundation Details
4. TS4-4 Junction Box- Small

1. TS4-5.1 Junction Box- Large Installation Details
2. TS4-5.2 Junction Box- Large Lid Details

6. TS4-6 Electrical Junction Box for Non-Deliberate Traffic Use Installation Details
7. TS4-7 Electrical Conduit Installation Details

TS5-1 Cabinet Grounding System Details TS6-1 Fiber Optic PVC Conduit Details

1. TS7-1.1 Traffic Signal Poles & Foundations Details
2. TS7-1.2 Traffic Signal Poles & Foundations Details
3. TS7-1.3 Traffic Signal Poles & Foundations Details
4. TS7-1.4 Traffic Signal Poles & Foundations Details
5. TS7-1.5 Traffic Signal Poles & Foundations Details
6. TS7-1.6 Traffic Signal Poles & Foundations Details
7. TS7-1.7 Traffic Signal Poles & Foundations Details
8. TS7-1.8 Traffic Signal Poles & Foundations Details
9. TS7-1.9 Traffic Signal Poles & Foundations Details
10. TS7-1.10 Traffic Signal Poles & Foundations Details
11. TS7-1.11 Traffic Signal Poles & Foundations Details

2. TS7-2 Steel Signal Pole Wiring & Rigging Details
3. TS7-3 Wood Pole Wiring & Rigging Details
4. TS7-4 Traffic Signal Head Wiring Details
5. TS7-5 Pedestal Pole Details

1. TS7-6.1 Polara APS Pushbutton Details
2. TS7-6.2 Polara EZCommunicator Navigator Configurator Details
3. TS7-6.3 Polara EZCommunicator Central Control Unit (CCU) w/ Ethernet Details

1. TS7-6.4a EZComm Navigator 2-Wire Order Form Details
2. TS7-6.4b Polara EZCommunicator V oice Message Details

7. TS7-7 Mushroom Type Pushbutton Switch Details
8. TS7-8 Sensor Loop Installation Details
9. TS7-9 Loop Detector Stub Out Details

1. TS7-10.1 6’ x 20’ Loop Details
2. TS7-10.2 6’ x 40’ Loop Details

List of Traffic Signal Details (Continued)

11. TS7-11 Overhead Electric Service Details
12. TS7-12 Underground Electric Service Details

1. TS7-13.1 Standard Meterpan Details
2. TS7-13.2 Standard Meterpan Details

14. TS7-14 Closed Circuit Television Camera Details
15. TS7-15 HAWK Signal Cabinet Wiring Details
16. TS7-16 Thermal Traffic Detecting Camera Details
17. TS7-17 Ethernet Switch Details
18. TS7-18 Connector, Category 5E Details
19. TS7-19 Fiber Optic Spice Enclosure
20. TS7-20 Patch Panel Assembly

List of Lighting Details

1. LT-1.1 Aluminum Octaflute Lighting Standard
2. LT-1.2 Aluminum Octaflute Lighting Standard

2. LT-2 Aluminum Octaflute Lighting Standard with Rear Mount
3. LT-3 Side Mount Luminaire Arm Detail
4. LT-4 Luminaire Fixture Detail

LT-5.1 Luminaire Fixture Detail LT-5.2a,b Relume Retrofit Streetlight System

6. LT-6 Ornamental Cast Aluminum Twin Luminaire Arm
7. LT-7 Carlyle Aluminum Lighting Standard
8. LT-8 Carlyle Lighting Details Foundation
9. LT-9 Breakaway Support System for Light Poles Details
10. LT-10 Streetlight Pole Foundation Details (Aluminum Monotube Type)
11. LT-11 Streetlight Pole Foundation Offset Detail
12. LT-12 Street Lighting Wiring Detail
13. LT-13 Carlyle Pole Foundation Type F-1 Detail

1. LT-14.1 Polytech Pole Standard
2. LT-14.2 Carlyle Pole Standard – Polytech Pole (On Foundation)

15. LT-15 Overhead Electric Service Details

16. LT-16 Junction Box - Small

PART I:
TRAFFIC SIGNAL SPECIFICATIONS

1

SECTION 1: GENERAL REQUIREMENTS

1. **1.01: SCOPE OF INTENT**

   These specifications describe the installation of necessary material, equipment and work procedures to complete traffic signals and/or other electrical systems as shown on the drawings, in the special contract provisions, or herein, for projects in the USA. These specifications provide minimum functional requirements that must be satisfied for all such work.

2. **1.02: ROADWAY WORK AND PERMIT**

   Unless stated otherwise, all roadway and sidewalk work shall be in accordance with the latest version of the *Road and Bridge Standards.* For all work, the CONTRACTOR shall obtain a permit from the relevant state or county.

1.03: ENGINEER

County Project ENGINEER or authorized county personnel (ENGINEER) shall be the responsible person overseeing all work on the State or County's behalf.

1.04: PRIVATE ACCESS AND TRAFFIC CONTROL PLAN

The CONTRACTOR will be required to maintain access to all private driveways throughout the period of construction. The CONTRACTOR shall be required to erect, maintain, and remove all barricades, traffic control signs and devices. Such barricades and traffic control signs and devices shall be in accordance with the latest versions of the *Work Area Protection Manual*, *Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD)* published by the U.S. Department of Transportation, Federal Highway Administration, and as directed by the ENGINEER. Construction signs not applicable during non-construction times shall be set so traffic cannot see the signs, as per Section 512 of the *Department of Transportation Standard Specifications for Road and Bridge Construction (latest edition).* Should this not occur, Section 1.11 shall be enforced.

A Traffic Control plan prepared by a certified traffic control supervisor shall be submitted and approved prior to issuance of the permit by the Department of Environmental Services.

The Traffic Control plan shall be submitted along with a set of construction drawings signed and approved by the State or County. The CONTRACTOR shall submit the plan at least 5 working days in advance of the intended start date. An approved copy will be kept at the site and shall be exhibited upon request to any authorized representative of the State or County. We reserve the right to require the CONTRACTOR to modify the traffic control in the field as necessary. We also reserve the right to issue a stop work order.

5. **1.05: TESTING**

   The County may at its option and cost retain the services of an independent testing lab to perform all testing consultation and to assist in the review of the work and equipment. See Section 7.09 for requirements regarding early delivery of controller and cabinet to County, for testing purposes.

6. **1.06: EQUIPMENT SALVAGE**

   All traffic signal equipment that is removed shall remain the property of The County. Such property is to be removed from the work site, tagged with date removed and location, and returned by the CONTRACTOR. When signal pole and mast arm assemblies are removed, all components shall be marked as a set with permanent markings. The equipment shall be returned in the same condition as removed. Contact the Traffic Signal Supervisor to coordinate delivery.

7. **1.07: EXISTING TRAFFIC SIGNALS**

   When existing traffic signal installations are modified or completely rebuilt, the CONTRACTOR shall work around existing traffic signal equipment until the new or modified traffic signal system has been installed and put into operation. Signal heads installed on standards or poles for new installation, which are not ready for actual electrical operation, shall be bagged with either black plastic or a suitable non-transparent material. The CONTRACTOR shall at all times maintain operation of a minimum of two (2) three section (red, yellow, and green) traffic signal heads and pedestrian heads (if required) for each roadway approach. Special consideration shall be made to avoid the left turn trap situation.

8. **1.08: INTERSECTION POWER**

   Unless otherwise directed in the plans, CONTRACTOR shall coordinate with The County project manager to obtain power hook-up to the intersection and luminaries two weeks prior to signal flash, if the unit installation is for a 100% off grid signal then this is only required if backup power is specified. See Section 7.15.

9. **1.09: UTILITIES**

   Utilities are shown on the plans to the extent that they can be, based upon records and surface field indications. All utility locations will require field verification in cooperation with the affected utility companies and public agencies. The CONTRACTOR shall follow the guidelines and procedures set forth in the

Professional Excavator's Manual and maintain responsibility for locating all gas, electric, and sewer laterals, valve boxes, manholes, etc., and insuring that they are properly protected and that signal equipment locations are adjusted accordingly, with approval from the ENGINEER.

10. **1.10: WORK HOURS**

No lane closures or sidewalk work is permitted between the hours of 6:30-9:30 am and 4:00-6:30 pm.

11. **1.11: FAILURE TO COMPLETE WORK ON TIME**

A daily charge will be made against the CONTRACTOR for each calendar day that any work remains uncompleted after the elapse of contract time. This daily charge will be deducted from any money due the CONTRACTOR. This deduction will not be considered a penalty but as liquidated damages.

Due account shall be taken of any adjustment of the contract time for completion time of the work granted by the ENGINEER at the ENGINEER'S discretion, due to supplier delays beyond the control of the CONTRACTOR. CONTRACTOR shall provide written documentation of such delays.

Permitting the CONTRACTOR to continue and finish the work or any part thereof after elapse of contract time will not operate as a waiver on the part of the County of any of its rights under the contract.

Any deduction assessed as liquidated damages under this subsection shall not relieve the CONTRACTOR from liability for any damages or costs resulting from delays to other contractors on the project or other projects caused by a failure of the assessed CONTRACTOR to complete the work according to contract times.

12. **1.12: JOB SITE CONDITIONS**

CONTRACTOR shall maintain a safe and clean job site throughout construction. Upon project completion, the job site shall be neat and clean with all trash, dirt picked up, and barricades removed. Landscaping shall be restored, and sidewalks swept as needed. The intent is that the job site appears as good as or better than it appeared before construction.

13. **1.13: REFERENCE DOCUMENTS**

All equipment and material shall conform to the standards of the:

- Institute of Transportation Engineers (ITE)
- International Municipal Signal Association (IMSA)
- Department of Transportation *Standard Specifications for Road and Bridge Construction (latest edition)*

In addition to requirements of these specifications, the plans, standard details, and the special contract provisions, all material and work shall conform to the requirements of the:

- • *MUTCD*
- • *National Electrical Code (N.E.C.)*
- • *National Electrical Safety Code (N.E.S.C.)*
- • *Rules for Overhead Electrical Line Construction of Public Utilities*

  Commission (Rules), the

- • *Standards of the American Society for Testing and Materials (ASTM)*
- • *American National Standards Institute (ANSI)*
- • Any local ordinances, which may apply.

  Wherever reference is made in these specifications or in the special contract provisions to the *MUTCD, NEC, NESC,* Rules, or the standards mentioned above, the reference shall be construed to mean the document that is in effect at the date of bidding.

SECTION 2: EXCAVATING AND BACKFILLING 2.01: GENERAL

The CONTRACTOR shall contact the county Roadways Inspector's office prior to any excavating activities. Street cuts for conduit on existing pavements shall not be allowed unless approved by the Roadway Inspector. Excavations for the installation of conduit, foundations, and other equipment shall be performed in such a manner as to cause the least possible damage to the streets, sidewalks, and other improvements/landscape and sprinklers. The trenches shall not be excavated wider than necessary for the proper installation of the electrical appliances and foundations and shall be kept clean and as free of moisture as possible. Excavations shall be backfilled or poured with concrete within 24 hours of opening, unless otherwise approved in writing by the ENGINEER. The material from the excavation shall be removed as the trenching progresses.

Excavations, after backfilling, shall be kept well filled and maintained in a smooth and well-drained condition until permanent repairs are made.

Excavating and backfilling for foundations shall be incidental to the pay item for which a foundation is required. Excavating and backfilling for conduit trenches shall be paid for under the appropriate conduit trenching pay item.

Laterals are not owned by the County. The CONTRACTOR shall locate all laterals prior to excavating in accordance with *The Professional Excavator's Manual*.

2.02: MAINTENANCE OF TRAFFIC

At the end of each day's work and any other time construction operations are suspended, all construction equipment and other obstructions shall be removed from that portion of the roadway open for use by public traffic. Construction signs not applicable during non-construction times shall be set so traffic cannot see the signs. Should this not occur, Section 1.11 shall be enforced.

Excavations in streets or highways shall be performed in such a manner that at least one (1) lane of traffic in each direction shall be open to public traffic at all times. All lane closures shall be approved by ENGINEER prior to closure.

When excavations must remain open overnight, they shall be properly marked to warn motorists and/or pedestrians according to the *Work Area Protection Manual* and the *MUTCD.* Barricades with lights shall be provided, unless otherwise authorized in writing by the ENGINEER.

SECTION 3: REMOVING, REPLACING AND RESETTING IMPROVEMENTS 3.01: GENERAL

The CONTRACTOR shall at his sole expense, replace or reconstruct sidewalks, curbs, gutters, rigid or flexible pavement, and any other improvements removed, broken, or damaged by him with material and methods that conform to current County standards.

Whenever a part of a square or slab of existing concrete, sidewalk, or driveway is broken or damaged, the entire square or slab shall be removed, and the concrete reconstructed as above specified.

Concrete pavement and sidewalk designated for removal shall be removed as marked by the ENGINEER.

The concrete pavement or sidewalk shall be cut to the existing depth of concrete prior to removal. Any over break, separation or other damage to the existing concrete outside of the designated removal limits shall be replaced at the CONTRACTOR'S expense. Payment for removal of concrete pavement or sidewalk shall be based on square yards of surface area regardless of the concrete thickness.

Removal items shall be as indicated in the pay item list. Removal of poles and controllers shall include foundation removal to the depth indicated by the ENGINEER. Otherwise, removal shall consist of complete elimination of the specified items.

The "REMOVAL OF TRAFFIC SIGNAL EQUIPMENT" pay item shall consist of the items specifically identified on the plans, or in writing by the ENGINEER. It shall be the CONTRACTOR'S responsibility to assure that he has a full and complete understanding prior to bidding.

Reset pay items shall be as indicated in the pay item list. These items are to be initially removed, then adjusted or modified as directed by the ENGINEER, and finally reinstalled to full operational capability. Modifications and adjustments shall be detailed on the plans or project special provisions and shall be incidental to the reset pay item.

The "RESET TRAFFIC SIGNAL EQUIPMENT" pay item shall consist of the items specifically identified in the plans or in the project special provisions.

SECTION 4: UNDERGROUND FACILITIES 4.01: FOUNDATIONS

All foundations shall be Portland cement concrete conforming to the applicable requirements of construction standards, except as herein provided.

The bottom of concrete foundations shall rest on firm ground. Cast-in-place foundations shall be poured monolithically where practicable. The exposed portions shall be formed to present a neat appearance. Concrete shall be of the highest-Class type per the latest edition of Standard *Specifications for Road and Bridge Construction (latest edition).*

Forms shall be true to line and grade. Tops of foundations, except as noted on plans, shall be finished to curb or sidewalk grade or as ordered by in ENGINEER. Forms shall be rigid and securely braced in place and inspected prior to the pouring of concrete. Conduit ends, and anchor bolts shall be placed in proper position and in a template until the concrete sets.

Anchor bolts shall conform to the manufacturer's specifications and each individual bolt shall have two (2) flat washers and two (2) nuts. Shims or other similar devices for plumbing or raking will not be permitted. Stirrups shall be installed on all foundations. Both forms and ground that will be in contact with the concrete shall be thoroughly moistened before placing concrete. Forms shall not be removed until the concrete has thoroughly set.

All pole foundations shall have a 6-bolt pattern unless otherwise authorized in writing by the county engineer.

EcoPav is considered as a possible alternative and will be dealt with in the final specification list if approved.

Whenever excavation for a foundation requires removal of excess ground materials, the excavation shall be backfilled to within 12" of ground level with 60-120 PSI Class M concrete, and then backfilled to ground level with native material compacted per the ENGINEERS' direction.

Any abandoned foundation located a minimum of 12" from the surface shall be fully or partially removed and disposed of by the CONTRACTOR per the direction of the ENGINEER. Any conduit runs associated with an abandoned foundation shall be capped or abandoned as called for on the plans.

Construction

Work shall conform to details TS4-1.1, TS4-1.2, TS4-2, TS4-3, TS7-1.10 and the requirements specified under Section 700 of the VDOT's *Standard Specifications for Road and Bridge Construction (latest edition)*.

Measurement and Payment

Concrete Foundations shall be measured and paid for at the contract unit price per each or cubic yards (CY) as applicable. When paid for in cubic yards of concrete, no payment will be made for concrete in excess of the cubic yards of concrete required by the foundation design unless otherwise approved by the ENGINEER. This shall include foundation design, concrete, reinforcing steel, stub poles, anchor bolts, bolt circle templates, grounding equipment, conduits, excavating, backfilling, compacting, disposing of surplus and unsuitable materials, and restoring existing areas. Removal and Replacement of existing concrete, asphalt, or brick sidewalk and/or pavement due to installation shall be incidental to Concrete Foundation Item.

All foundations shall be incidental to the pay item for which a foundation is required. Ground rods shall be provided as indicated in the standard details and shall be incidental to the installation pay item.

4.02: CONDUIT

All cables and conductors not shown on the plans as aerial cable shall be installed in conduit unless installed in poles, pedestals, or mast arms. All metal conduits referred to in the specifications and shown on the plans shall be the rigid pipe type of ductile steel that is adequately galvanized. All PVC conduits shall be Schedule 40 or heavier. Poly pipe commonly used for boring shall be Schedule 40 or heavier. All transitions from poly pipe to PVC shall be by means of an aluminium threaded coupling or Etco “E-LOC” couplings. These couplings shall be the only approved method for connecting the 90- degree sweep.

The CONTRACTOR, at his sole expense, may use larger conduit if desired. Where larger conduit is used, it shall be for the entire length of the run. No reducing couplings will be permitted underground.

The ends of all metal conduits, existing or new, shall be well reamed to remove burrs and rough edges. Field cuts of existing or new conduit shall be made square and true, and the ends shall butt together for the full circumference thereof. Slip joints or running threads will not be permitted for coupling metal conduit. When a standard coupling cannot be used, an approved threaded union coupling shall be used. All couplings shall be screwed tight until the ends of the metal conduits are brought together.

Where a "stub out" is called for on the plans, a sweeping ell shall be installed in the direction indicated and sealed with a metallic cap to facilitate future locating. The locations of ends of all conduits in structures or terminating at curbs shall be marked by a "Y" at least three inches (3") high cut into the face of the curb, gutter, or wall directly above the conduit.

Where factory bends are not used, conduit shall be bent without crimping or flattening, using the longest radius practicable. Conduit bends feeding junction boxes and foundations shall be as shown on the standard details, typically 18".

Conduit shall always enter a pedestal base, junction box, or any other type structure from the direction of the run only. Conduit connections at junction boxes shall be tightly secured.

Conduit terminating in a standard or pedestal shall extend approximately two inches (2") above foundation vertically.

All conduit runs that exceed ten feet (10') in length shall have a continuous 1/8” or 1/4" nylon rope (blow line cannot be substituted but can be in addition to) pulled into the conduit along with the specified electrical cables. The line shall be firmly secured at each end of the conduit run with a minimum slack of four feet (4'). The purpose of this rope is to be able to pull future electrical cable through the existing conduit runs and the rope shall not be tangled or twisted around cables.

Existing underground conduit to be incorporated into a new system shall be cleaned with a mandrel or blown out with compressed air.

New conduit runs shown on the plans are for bidding purposes only and may be changed at the direction of the ENGINEER.

Any spare or unused conduits installed for future use shall be sealed with a metallic cap and a single 14 AWG stranded THHN wire through the entire run to facilitate future locating.

All conduit installed, including poly pipe, shall be at full depth for the entire conduit run. 90-degree sweeps shall not be cut to achieve proper entrance to junction box. Conduit runs shall have no more than a 180-degree bend.

All conduits in junction boxes shall extend a minimum of 3” above crushed rock.

All conduits shall terminate in junction boxes such that when cable is pulled and coiled within the junction box, there is a minimum clearance of 3” between the junction box lid and the conduit and cable. Cable and conduit shall not be crushed or damaged.

All underground conduit runs shall have a single 14 AWG stranded THHN wire installed from junction box to junction box for locating purposes.

The CONTRACTOR shall be required to conduct Test Bores where new conduit crosses underground utilities, as specified on the plans or as directed by the ENGINEER, to ensure adequate utility clearances are met.

Construction

Work shall conform to details TS4-7 and the requirements specified under Section 700 of the VDOT’s *Standard Specifications for Road and Bridge Construction (latest edition)*.

Measurement and Payment

Conduit shall be measured and paid for at the contract unit price per linear foot (lf). This shall include conduit bodies, fittings, bonding systems, pull ropes, pull tapes, plastic spacers, 14 AWG stranded THHN when required, junction or splice boxes with an area of 512 cubic inches or less, supports, aggregate, and protective metal shields.

Test Bores shall be measured and paid for at the contract unit price per each. This shall include the test bore and backfilling as required.

4.03: JUNCTION BOXES

A junction box shall be installed at all locations shown on the plans and at such additional points as ordered by the ENGINEER.

At sites where, operational traffic signals are being installed, permanent pre-cast junction boxes shall be installed.

Junction boxes shall be installed so that the covers are level with curb or sidewalk grade or level with the surrounding ground when no grade is established. The entire excavation required to install 90-degree sweeps into a future junction box shall be backfilled from the full depth of the conduit run to the bottom of the junction box with crushed rock. The depth of gravel from the bottom of the excavation to the bottom of the junction box shall be a minimum of 12 inches.

The interior of the junction box shall be backfilled with crushed rock from the base of the junction box to a maximum depth of 12” below the conduit runs. The area of the excavation surrounding the junction box may be backfilled with excavated soil.

When a new conduit run enters an existing junction box, the CONTRACTOR shall temporarily knock out or tunnel under the side at no less than eighteen inches (18") below the junction box bottom and enter from the direction of the run. All backfill shall be gravel. No new conduit will be allowed to enter a new or existing junction box in any other manner than that shown on the standard details.

All junction boxes that utilize metal lids shall be painted black in accordance with Section 231 and 411 of VDOT’s *Standard Specifications for Road and Bridge Construction (latest edition)* and grounded in accordance with Section 5.2 of this document.

The CONTRACTOR shall provide to The County a written warranty against any defects in materials and workmanship for a period of one year from the time of delivery to The County.

Construction

Work shall conform to details TS4-4, TS4-5.1, TS4-5.2, TS4-6 and the requirements specified under Section 700 of VDOT’s *Standard Specifications for Road and Bridge Construction (latest edition)*.

Measurement and Payment

Junction Boxes shall be measured and paid for at the contract unit price per each. This shall include concrete collars, frames and covers, tools to remove the cover, ground rods, ground conductors, grounding lugs, knockouts, cable racks, aggregate, excavating, backfilling compacting, disposing of surplus and unsuitable material, and restoring existing areas.

Removal and Replacement of existing concrete, asphalt, or brick sidewalk and/or pavement due to installation shall be incidental to Junction Box Item.

SECTION 5: CONDUCTOR AND CABLE 5.01: GENERAL

Wiring shall conform to appropriate articles of the N.E.C. Wiring within cabinets, junction boxes, etc., shall be neatly arranged.

Powdered soapstone, talc, or other approved lubricant shall be used in placing conductors in conduit. Unless otherwise approved by the ENGINEER, wiring shall not occupy more than 40% of the inside area of all conduit. If more than 40% of the inside area is occupied, the CONTRACTOR shall provide additional conduit to satisfy this requirement.

A 1/8" or 1/4” nylon pull rope shall be installed in all new conduits and in all existing conduit where a cable is added or an existing cable is replaced. A minimum of four feet (4') of slack shall be left in each conduit at each termination.

At least five feet of slack shall be left for each conductor at each span wire support pole.

Splices shall be kept to a minimum and will only be allowed in junction boxes and at pole bases. A minimum of twenty-four inches (24") of slack shall be left on each splice wire. In no case shall any shellac compounds be used.

Detector loop lead-in splices in junction boxes (see Paragraph 6.40a) shall be fully waterproofed using a splice kit or epoxy wire nuts (Buchanon BTS2 or BTS4 or approved equal). A minimum of twelve inches (12") of slack shall be left on the detector loop.

When conductors and cables are pulled into the conduit, all ends of conductors and cables 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 be taped and marked.

All wiring shall use either 19 conductors or 21 conductors per cable for high voltage (exceeding 50 volts). Conductor cable shall be installed where required in the plans. Overhead cable shall be secured to messenger cable with cable rings or stainless-steel wire wrap only.

A separate wire shall be provided for luminary power and shall be 12-gauge, 2 conductors with a ground and UF wire with underground feed.

Signal heads mounted on mast arms are to be wired individually from the head to the hand hole at the bottom of the pole.

Four-approach intersections shall be initially wired to all poles to handle eight vehicle phases plus four pedestrian phases. "TEE" intersections shall be initially wired to all poles to handle at least five (5) vehicle phases and three (3) pedestrian phases. At least three spare conductors shall be provided from the controller cabinet to the hand hole of each signal pole.

Span wire and tether cable shall be affixed to the pole using short bail strand vices. If required by the ENGINEER insulators shall be provided, in which case long bail strand vices shall be used.

5.02: CONDUCTOR LABELING

A small permanent tag on which the direction and phase is printed, using the codes given in "Conductor Schedule" below, shall be securely attached near the end of each conductor or group of conductors grouped per phase or function at each controller and signal pole. Loop detector lead-ins shall be tagged in the splice junction box behind the curb. Conductor Schedule:

Key-Phase: Colour of Signal Load Conductor, "Code" (on tag at each end of conductor)

1. Northbound Left Turn: Red/White, "x-NBLT"
2. Northbound: Red, "x-NB"
3. Southbound Left Turn: Green/White, "x-SBLT"
4. Southbound: Green, "x-SB"
5. Eastbound Left Turn: Orange/White, "x-EBLT"
6. Eastbound: Orange, "x-EB"
7. Westbound Left Turn: Blue/White, "x-WBLT"
8. Westbound: Blue, "x-WB"
9. Pedestrian: Yellow, "x-PED"
10. Supplemental: Purple, “Advance detection”

NOTE: x = phase number. This is a typical conductor schedule and shall be used for the wiring of all signal installations. A new conductor schedule will be noted on the plans at each intersection where different phasing and/or special equipment is required. It should be noted that a band of white is used to indicate a left turn, and yellow is used for a pedestrian movement.

Detector conductors shall be tagged at their ends with color-coded electrical tape following the above schedule, including the movement "Codes" (e.g., "1-NBLT"). Each pedestrian push button shall have a dedicated wire pair lead-in to the TS-2 controller cabinet.

5.03: MATERIALS

Refer to Section 6 for details regarding signal communications cable.

14 AWG 7 Conductor Cable

• Cable shall be stranded copper. Each individual conductor shall be insulated with polyethylene and twisted for maximum flexibility. The conductors grouped together shall be covered by a polyvinyl chloride outer jacket. Cable must meet IMSA cable specification 19-1.

18 AWG 3PR

• Conductors shall be stranded tinned copper with polyethylene insulation. Conductors are to be twisted pair with aluminium mylar shield. The outer jacket shall be polyethylene with rip cord under jacket. Cable must meet IMSA cable specification 50-2.

14 AWG 3 Conductor Cable

• Cable shall be stranded copper. Each individual conductor shall be insulated with polyethylene and twisted for maximum flexibility. The conductors grouped together shall be covered by a polyvinyl chloride outer jacket. Cable must meet IMSA cable specification 19-1.

Extra High Strength Strand Cable

• Strand cable to be 3/8-inch galvanized steel (Class A) with 7 wires per stand. Minimum breaking strength shall be 15,400 lbs.

12 AWG 2 Conductor UF Cable with Ground

- • Conductors shall be soft uncoated copper per ASTM-B3.
- • Conductor insulation and jacket shall be colour coded PVC (polyvinyl chloride) rated

  at 90 degrees centigrade.

- • Grounding conductor also shall be soft uncoated copper per ASTM-B3. Conductors

  to be encased in a grey sunlight resistant PVC jacket, which is applied directly over and around the insulated and bare conductors. Insulated conductors and ground are to be laid parallel within the jacket.

5.04: BONDING AND GROUNDING

Metal poles, pedestals and cabinets shall be made mechanically and electrically secure to form a system of isolated grounded components. Each pole and pedestal shall have a separate ground rod, located either through the foundation into surrounding ground, or in an adjacent junction box and connected to the system component. The controller cabinet shall have a ground rod located in its foundation. Separate ground rod locations shall not be directly connected to one another with ground wire, in order to minimize transient distribution among the components.

Bonding and grounding jumpers shall be copper wire, No. 8 AWG, for all systems. Loop lead-in drain wire is to be grounded in the control cabinet only. The other end of the sheath is to be taped and left ungrounded.

Bonding of standards and ground rods shall be by means of connecting to the ground rod, a bonding strap attached to an anchor bolt or a 3/16” diameter or larger brass or bronze bolt installed in the lower portion of the shaft. (Per VDOT’s *Standard Specifications for Road and Bridge Construction (latest edition)*)

At each grounded junction box, the ground electrode shall be a one-piece copper ground rod driven into the ground so that the top is at least two to four inches (2” to 4") below the bottom of the junction box lid. The ground rod connector shall be placed so that the bare copper wire, No. 8, can be pulled into a pole, pedestal, or attached to the control cabinet ground buss.

Metal cover shall be grounded as per NEC specification.

Construction

Work shall conform to detail TS5-1, and the requirements specified under Sections 238 and 700 of the VDOT's *Standard Specifications for Road and Bridge Construction (latest edition)*.

SECTION 6: SIGNAL COMMUNICATIONS CABLE AND CONDUIT 6.01: GENERAL

The CONTRACTOR shall contact The County direct with questions regarding any conduit found in the field.

2. **6.02: COPPER WIRE**

   19 AWG 12pr Communications Cable:

   Conductors shall be solid copper and insulated with solid polyolefin and colour coded to industry standards. Conductors are to be twisted into pairs and wrapped in a polyethylene jacket (non-gel filled). Cable must meet IMSA cable specification 19-2.

3. **6.03: FIBER-OPTIC CABLE Conduit Requirements**

   Where provided, all fiber optic cable shall be installed in 2" HDPE conduit. Provide conduit with a coefficient of friction of 0.09 or less in accordance with Telcordia GR-356. Provide factory lubricated, low friction, coilable, conduit constructed of HDPE. Provide conduit with smooth outer wall and smooth inner wall. Ensure conduit is capable of being coiled on reels in continuous lengths, transported, stored outdoors, and subsequently uncoiled for installation without affecting its properties or performance.

   Cable Specifications

   Furnish loose tube fiber-optic cable of the required fiber count that complies with RUS CFR 1755.900, single mode with a dielectric central member. Use single mode fiber in the cable that does not exceed an attenuation of 0.25 dB/km at 1550 nm and 0.35 dB/km at 1310 nm. Provide cable with all fibres that are useable and with a surface sufficiently free of imperfections and inclusions to meet optical, mechanical, and environmental requirements. Provide cable with a minimum of one ripcord under the sheath for easy sheath removal and with a shipping, storage, installation, and operating temperature of at least -40 to 160 degrees F.

   Have a dual layered, UV cured acrylate fiber coating applied by the cable manufacturer that may be stripped mechanically or chemically without damaging the fiber.

Provide fibres inside a loose buffer tube. Use a doped silica core surrounded by concentric silica cladding for each fiber. Distinguish each fiber and buffer tube from others by means of color-coding meeting the requirements of EIA/TIA-598, “Colour Coding of Fiber-Optic Cables.” In buffer tubes containing multiple fibres, ensure that the colours are stable during temperature cycling and not subject to fading, sticking, or smearing into each other or into the gel filling material. Use fillers in cable core if necessary to provide a symmetrical cross-

section of cable. Fill buffer tubes with nonhygroscopic, non-nutritive to fungus, electrically non-conductive, homogenous gel. Ensure that gel is free from dirt and foreign matter and is removable with conventional nontoxic solvents.

Provide a central member consisting of a dielectric glass reinforced plastic rod. Apply binders with sufficient tension to secure buffer tubes and binders to the central member without crushing buffer tubes. Ensure that binders are non-hygroscopic, non-wicking (or rendered so by the flooding compound), and dielectric with low shrinkage.

Provide cable that has cable core interstices filled with super-absorbent, water-blocking compound that is non-conductive and homogenous. Ensure that compound is free from dirt and foreign matter and is removable with conventional nontoxic solvents.

Provide cable with high tensile strength aramid yarns or fiberglass yarns that are helically stranded evenly around the cable core.

Provide cable jacket of consistent thickness that is free of holes, splits, and blisters, and containing no metal elements. Provide outer jacket of medium density polyethylene with minimum nominal sheath thickness of 0.050 inch. Ensure that polyethylene contains carbon black for ultraviolet light protection and does not promote the growth of fungus.

Provide length markings in sequential feet and within one percent of actual cable length. Ensure that character height of the markings is approximately 0.10 inch. Cabling shall include cable identification markers.

6.04: PLENUM RATED SMFO CABLE

Where called for on the plans and all cabling routed inside buildings, the SMFO cable shall be an indoor/outdoor Plenum/OFNR-rated cable.

The Plenum/OFNR cable shall comply with Bellcore GR-409-Core, Generic Requirements for Premises Fiber Optic Cable and with Bellcore GR-20-Core, Generic Requirements for Optical Fiber and Fiber Optic Cable. The Plenum rated cable shall meet all other operating characteristics of the SMFO communications cable. Plenum rated cables shall have a maximum 0.65 dB/km loss at 1310 nm.

Construction

Work shall conform to details TS6-1 and the requirements specified under Section 700 of the VDOT’s *Standard Specifications for Road and Bridge Construction (latest edition)*.

Measurement and Payment

All electrical cable(s) shall be measured and paid for at the contract unit price per linear foot (lf), for each respective cable.

6.05: CNGE2FE16MS MANAGED ETHERNET SWITCH
Managed Ethernet Switch with (16) 10/10TX + (2) Configurable 10/100/1000TX / 100/1000FX Ports

The CNGE2FE16MS Managed Ethernet Switch provides robust transmission of (16) 10/100 BASE-TX and (2) 10/100/1000TX or 100/1000FX combo ports, of gigabit Ethernet data. Unlike most Ethernet switches, these environmentally hardened units are designed for direct deployment in difficult out-of-plant or roadside operating environments and are available for use with either conventional CAT-5e copper or optical transmission media. Diverse media selection allows for easy implementation of point-to-point, linear add-drop, drop-and-repeat, star, or true self-healing ring and mesh network system architectures. The 16 electrical ports support the 10/100 Mbps Ethernet IEEE 802.3 protocol, and auto, negotiating and auto-MDI/MDIX features are provided for simplicity and ease of installation. 2 ports are 10/100/1000 configurable for copper or fiber media for use with multimode or single mode optical fiber, selected by optional SFP modules. These network managed layer 2 switches are optically (100/1000 BASE-FX) and electrically compatible with any IEEE 802.3 compliant Ethernet devices. Plug-and- play design ensures ease of installation, and no electrical or optical adjustments are ever required. The CNGE2FE16MS incorporates LED indicators for monitoring the operating status of the managed switch and network. These units are DIN-rail or wall mountable.

Functional Requirements:

1. Environmentally hardened for direct deployment in difficult unconditioned out-of-plant and roadside installations.
2. Tested and certified by an independent laboratory for full compliance with the environmental requirements (ambient operating temperature, mechanical shock, vibration, humidity with condensation, high-line/low-line voltage conditions and transient voltage protection) of NEMA TS-1/TS-2 and CALTRANS Traffic Signal Control Equipment Specifications.
3. Compliant with EN60950-1 and UL Class 1, division 2, Groups A, B, C and D for Hazardous Locations.
4. Extended ambient operating temperature range: -40° C to +75° C (Functional to 85°C)
5. 10/100 BASE-TX and 100/1000 BASE-FX compatible
6. Flexible optics configuration via SFP plug-in modules
7. DIN rail or wall-mountable mounting
8. Redundant power supply compatibility reduces possibility of single-point-of-failure for highest possible reliability
9. Fully configurable through web-based or SNMP network management
10. IGMP Snooping V1/V2 for multicast filtering and IGMP Query V1/V2
11. Port based VLAN (IEEE 802.1Q)
12. 12. Rapid Spanning Tree protocol (IEEE 802.1W)
13. 13. Power Supply Included
14. 14. Lifetime Warranty

Construction

Work shall conform to details TS7-17 and the requirements specified under Section 700 of the VDOT's *Standard Specifications for Road and Bridge Construction (latest edition)*.

Measurement and Payment

Ethernet Switch shall be measured and paid for at the contract unit price, each (EA).

6.06: COPPER AND OPTICAL FIBER ETHERNET CONNECTORS Description

MSA Compliant Small Form-Factor Pluggable (SFP) modules allow for an optical or copper interface when using a managed switch, unmanaged switch or media converter. These interchangeable SFP modules are available for use with copper media, or multimode and single mode optical fiber. The optical fiber SFP modules are available in fast Ethernet on and two fiber versions and Gigabit one and two fiber versions. They also are available with LC or SC optical connectors. The SFP modules have different wavelengths and optical power to offer distances from 300 meters to 120 kilometres. These SFP modules are industrially rated to perform in the most difficult operating environments.

Functional Requirements

1. Transparent to data encoding/compatible with major data protocols.
2. Interchangeable SFP for Fiber type, distance and connector.
3. No in-field optical adjustments required.
4. Conforms to (SFP) Small Form-Factor Pluggable Multi-Source Agreement.
5. IEEE 802.3 compliant
6. Operating temperature: -40°C to +75°C.
7. Lifetime Warranty (see warranty pack)

Specifications

Mbps:
Transmission Medium*: Transmit Wavelength: Receive Wavelength: Maximum Path Length: TX Power (dBm):
RX Sensitivity (dBm): Opt. Loss Budget (dBm): Number of Fibers: Receptacle Type:

Measurement and Payment

1000
Single Mode 1310nm 1310nm
15 km
-8
≤-24
16

2
LC

SFP Modules shall be measured and paid for at the contract unit price, each (EA).

6.07: CORETEC UNIVERSAL DIGITAL VIDEO CODEC Description

The VCX-7401 single channel CODEC is a highly capable, field hardened product, which sets a new standard for encoding and decoding in challenging environments. The unit supports bi-directional simultaneous multi-protocol feeds over a full range of resolutions, as well as JPEG frame capture, through RJ-45 and multifunctional SFP interface. An on-board SD card slot allows supplemental storage and easy update.

Troubleshooting is assisted by the inclusion of a built-in decoder, providing an encoded-decoded video signal via BNC connector, and a RS-232 programming port. Local and remote diagnostics are provided through visual display, web interface, and SNMP.

The encoder allows easy transport and sharing of IP video with local, state & Federal agencies, simultaneously transmitting both high resolution & Internet quality video.

Detailed Specifications:

Video:

Input and Output # of channels

Standards

Voltage Compression

1 in; 1 out Composite BNC

NTSC (EIA RS-170) PAL (CCIR 624)

1 volt p-p 75Ω 50/60HZ

H.264 (High Profile SD 3.1) MPEG4 (ISO/IEC 14496 [ASP]) MPEG2 Elementary (ISO 13818-2) JPEG snapshot (FTP transfer)

Resolution & Maximum Frame Rate

D1 CIF QCIF

Data Range

Storage

Serial Data:

Protocol Programming Data Rate Connectors

Network:

Ethernet Interface Protocols

NTSC 720 x 480 352 x 240 176 x 120

1-30 fps PAL 720 x 526 352 x 288 176 x 144

56 Kbps to 5 Mbps Removable SD or HDSD Card

RS-422/485 RS-232/422
9.6 to 57.6 Kbps (NRZ) RJ-45, USB 2.0

10/100BaseT, 100Base-FX, 100Base-SX (IEEE802.3/802.3u)
RJ-45, USB 2.0
Ipv.4, UDP, TCP, RTP, RTSP, HTTP, FTP, TFTP, SNMP 2.0, IGMP V2 Multicast, SMTP, SAP, ICMP, ARP

Programming & Diagnostics:

Modes Physical

Remote Visual

LED's

Electrical:

Voltage
Power Consumption

Mechanical:

Dimensions Mini-Module Card

Weight

RS-232 programming port Telnet, Web Interface, SNMP

Video Loss, Data, Power

9-48 VDC, 9-35 VAC <10W

5.88"W x 1.75"H x 6.14"D 5.5"W x 11"H
<2 lbs.

Environmental & Regulatory:

NEMA TS2 Shock, Vibration and Transients Temperature (-)36°C to +74°C (Operating)

(-)40°C to +74°C (Storage)

Humidity 0 to 95% Non-condensing (Conformal Coating Available Upon request)

Construction

Work shall conform to details TS7-14 and the requirements specified under Section 700 of the VDOT's *Standard Specifications for Road and Bridge Construction (latest edition)*.

Measurement and Payment

Coretec Universal Digital Video CODEC shall be measured and paid for at the contract unit price, each (EA).

6.08: FIBER-OPTIC SPLICE ENCLOSURE General

1. Furnish splice enclosures that are re-enterable using a mechanical dome-to-base seal with a flash test valve, and that are impervious to the entry of foreign material (water, dust, etc.). Ensure that enclosures are manufactured in such a manner to be suitable for junction box and manhole installation.
2. Provide enclosures with a minimum of one over-sized oval port that will accept two cables and with a minimum of four round ports (for single cables) which will accommodate all cables entering the enclosure. Provide gel-sealing or heat shrink cable shields with the enclosure to ensure that a weather tight seal where each cable enters the enclosure.
3. Within enclosures, provide the minimum necessary number of hinged mountable splice trays to store the number of splices required, plus the capacity to house six additional splices. Provide a fiber containment basket for storage of loose buffer tubes that are expressed through the enclosure. Ensure that enclosures allow sufficient space to prevent micro bending of the buffer tubes when coiled.
4. Provide splice trays that hold, protect, and organize optical fibres, and that secure fibres inside the splice tray.
5. Provide splice trays that are dielectric.
6. Provide splicing enclosures and associated equipment with an operating temperature of - 20 to 160 degrees F.

Termination and Splicing within Splice Enclosure

1. Install fiber optic splice enclosures to meet the following specifications:
2. Install splice enclosures with splice trays and all other necessary hardware.
3. According to the Plans, fusion splice and secure SMFO cable in splice trays inside the splice enclosure.
4. For all buffer tubes designated to be expressed (not cut) through the splice enclosure, neatly coil the excess tubing inside the basket provided with the enclosure.
5. Ensure that all buffer tubes are contained within the splice tray so that no bare fibres are outside the tray.

6. Do not damage the fiber or exceed the minimum bending radius of the fiber.
7. Label all fiber-optic splices. Obtain the Engineer's approval of the method of labelling all fiber-optic connections.
8. Install gel-sealing or heat shrink cable shields using methods recommend by the manufacturer of the enclosure. Perform a pressurization flash test on the enclosure in

accordance with the manufacturer's recommend procedures at the conclusion of the splicing procedure and prior to the final placement of the enclosure.

9. Place the enclosure along with required spare cables in the facility in a neat and workmanship like manner and insure that no standing water remains in junction box. Do not place the splice enclosure in bottom of junction box. Do not damage cable or violate the minimum bending radius of the cable.
10. Coil twenty five (25) feet of slack cable on each end of the splice enclosure.

Construction

Work shall conform to details TS7-19 and the requirements specified under Section 700 of the VDOT's *Standard Specifications for Road and Bridge Construction (latest edition)*.

Measurement and Payment

Splice Enclosure (Small) Each Splice Enclosure (Medium) Each Splice Enclosure (Large) Each

6.09: FACTORY TERMINATED PATCH PANEL ASSEMBLY General

Furnish factory terminated patch panel assemblies. The assembly shall consist of a single mode fiber optic cable with each fiber factory terminated in a protective housing. The cable shall consist of 12 fibres in a single buffer tube, a dielectric strength member, and a protective outer jacket. The fibres shall be single mode with attenuation not exceeding 0.35 dB/km at 1310 nm. The panel shall consist of LC type connectors. Furnish patch panels with cable lengths sufficient to meet the installation methods called for on the Plans.

Label all fiber-optic connectors, whether on jumpers, connector panels, or other equipment, to prevent improper connection. Obtain the Engineer's approval of the fiber-optic connectors labelling method.

Coil twenty-five (25) feet of slack cable on each end of the splice enclosure.

Construction

Work shall conform to details TS7-20 and the requirements specified under Section 700 of the VDOT's *Standard Specifications for Road and Bridge Construction (latest edition)*.

Measurement and Payment

Factory Terminated Patch Panel Assembly will be measured and paid for at the contract unit price per each for the actual number of factory terminated patch panel assemblies furnished, installed and accepted.

SECTION 7: TRAFFIC SIGNAL MATERIAL SPECIFICATIONS: 7.01: STEEL POLES

General

The CONTRACTOR shall provide to The County a written warranty against any defects in materials and workmanship for a period of one year from the time of delivery to the The County.

For warranty repairs, all costs of labour, parts and transportation to and from the CONTRACTOR shall be borne by the CONTRACTOR.

All poles shall be supplied with breakaway base support systems as specified on the plans. Breakaway base support systems shall conform to manufacturer requirements, and also conform to the breakaway requirements specified in AASHTO Specification for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.

Design

Design shall be in accordance with AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals", latest edition.

Loading shall be based on an isotach wind velocity of 80 miles per hour times a 1.3 gust factor.

All welding shall be in accordance with Sections 1 through 8 of the American Welding Society (AWS) D1.1 Structural Welding Code. Tackers and welders shall be qualified in accordance with the code.

Design Loading Requirements:

- • 0 to 40-foot mast arms will be loaded with three rigidly mounted 12-inch aluminium signal heads. The signal heads will be spaced every 11 feet starting from the free end of the arm. In addition, each mast arm will be loaded with one rigidly mounted 8 feet by 18-inch aluminium sign located in between the two outside signal heads.
- • 42 to 50-foot mast arms will be loaded with four rigidly mounted 12-inch aluminium signal heads. The signal heads will be spaced every 11 feet starting from the free end of the arm. In addition, each mast arm will be loaded with one rigidly mounted 8 feet by 18 inch aluminium sign located in between the two outside signal heads.
- • 52 to 60-foot mast arms will be loaded with five rigidly mounted 12-inch aluminium signal heads. The signal heads will be spaced every 11 feet starting from the free end of the arm. In addition, each mast arm will be loaded with one rigidly mounted 8 feet by 18 inch aluminium sign located in between the two outside signal heads.

Finishes

All poles, arms, transformer bases, and hardware shall be galvanized with black powder coating.

All poles, arms, transformer bases, and hardware shall be painted as specified on the plans or by the ENGINEER prior to installation.

Ornamental poles shall have a rust resistant coating applied to the inside of the pole. The colour of the outside of the pole will be specified at time of order. All poles, arms, ornamental bases, and hardware shall use one of the following coating systems:

Option 1:
• Primer = Dupont 25P Primer • Top Coat = Dupont 333 Imron

Option 2:
• Triglycidyl Isocyanurate (TGIC) polyester powder at a minimum thickness of 2.0

mils

7.02: NON-ORNAMENTAL POLES

The entire assembly shall be designed to meet the requirements of AASHTO Specification for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, latest edition for an 80 mph wind zone with a 1.3 gust factor (104 mph).

Material Data:
The materials used for construction shall meet the following requirements:

COMPONENT
POLE SHAFT
POLE BASE GALVANIZING-STRUCTURE GALVANIZING-HARDWARE ARM SHAFT

ARM CONNECTION
ARM CONNECTION BOLTS LUMINAIRE ARM SHAFT
LUMINAIRE ARM CONNECTION LUMINAIRE ARM CONNECTION BOLTS PLATE AND CHANNEL

ASTM DESIGNATION

MINIMUM YIELD (KSI)

55 36

55 36

36

28

A595 GR.A
A36
A123
A153
A595 GR.A
A36
A325 GALVD. TO A153 2" SCHEDULE 40 A27GR.65-35
SAE GR.5
A36

Mast Arm Pole Shafts:

Typically, there shall be four size categories of single arm mast arm poles: poles with 20 feet up to 40-foot arms; poles with 42 foot up to 50 foot arms; poles with 52 foot up to 60 foot arms; and poles with 62 foot up to 70 foot arms. To achieve interchangeability between poles and foundations, all of the poles in a size category shall have the same base plate size and bolt pattern.

Typically, there shall be three size categories of twin arm mast arm poles: poles with 20 feet to 40-foot arms; poles with 20 feet to 50-foot arms; and poles with 20 foot to 60 foot arms. To achieve interchangeability between poles and foundations, all of the poles in a size category shall have the same base plate size and bolt pattern.

Mast arm poles shall be 30 feet tall. The mast arm connection shall be located 20 feet above the base of the pole.

Each shaft shall include a 6-foot-long luminaire arm. An access hole shall be provided on the opposite side of the pole shaft from the mast arm at the same elevation as the centre of the mast arm. A second access hole shall be provided at the pole base.

- • **Fluted Mast Arm Pole Shafts:**
  Fluted pole shafts shall have 8 sharp flutes and shall have a constant linear taper. Pole shafts with mast arms longer than 40 feet (50-70 foot single/twin arms) shall have 16 sharp flutes with a constant linear taper. The shaft shall be one piece and contain no circumferential weld butt splices. Laminated tubes or round poles with separate fluted sheeting are not permitted. Each pole shall be provided with an end cap secured in place with set screws.
- • **Round Mast Arm Pole Shafts:**
  Multi-sided pole shafts are unacceptable. The shaft shall be one piece and contain no circumferential weld butt splices. The shaft shall have a constant linear taper. Each pole shall be provided with an end cap secured in place with set screws. Each pole shaft shall include a 6-foot-long luminaire arm. An access hole shall be provided on the opposite side of the pole shaft from the mast arm at the same elevation as the centre of the mast arm. A second access hole shall be provided at the pole base.

Mast Arms:

There shall be three size categories of mast arms: 20 foot to 40 foot arms, 42 foot to 50 foot arms, and 52 foot to 60 foot arms. To achieve interchangeability between arms and poles, all of the arms in a size category shall have the same connection plate size and bolt pattern.

Mast arms shall be round. Multi-sided and fluted mast arms are unacceptable. Mast arms shall have a constant linear taper of 0.14 inches per foot. The minimum thickness of steel shall be 7 gauge. Mast arms up to 40 feet in length shall be manufactured and shipped in one piece. Circumferential welded tube butt splices and laminated tubes are not permitted. Wire entrance holes 1-3/8 in diameter shall be drilled into the bottom of the arm every 11 feet starting at a point approximately 9 inches from the free end of the arm. Rubber grommets shall be installed in the wire entrance holes. Each arm shall be provided with an end cap secured in place with set screws.

All arms shall be supplied with clamps to allow free swing mounting of signal heads. Enough clamps shall be supplied to allow signal heads to be mounted every 11 feet.

Strain Poles:

Each pole shall have a 1.5" or larger telescoped wire inlet pipe located near the top of the pole. The inlet pipe shall be angled downward to prevent water from entering the pole. The base plate size and bolt pattern shall be the same for all strain poles to achieve interchangeability.

7.03: ROUND FLUTED ORNAMENTAL POLES

The entire assembly shall be of the same appearance of the attached drawings. The entire assembly shall be designed to meet the requirements of AASHTO for an 80-mph wind zone with a 1.3 gust factor (104 mph).

Material Data:

The materials used for construction shall meet the following requirements:

COMPONENT

ASTM DESIGNATION

A595 GR.A A36 A595 GR.A A36

A325 GALVD. TO A153 2" SCHEDULE 40 A27GR.65-35
SAE GR.5
A36

MINIMUM YIELD (KSI)

POLE SHAFT
POLE BASE

ARM SHAFT
ARM CONNECTION
ARM CONNECTION BOLTS LUMINAIRE ARM SHAFT
LUMINAIRE ARM CONNECTION LUMINAIRE ARM CONNECTION BOLTS PLATE AND CHANNEL

ORNAMENTAL BASE CAST ALUMINUM-356 F

Mast Arm Pole Shaft:

Pole shafts shall be 26 feet tall. The pole shaft shall have 16 sharp flutes and shall have a constant linear taper. The shaft shall be one piece and contain no circumferential weld butt splices. Laminated tubes or round poles with separate fluted sheeting are not permitted. A 3" x 5" handhole with cover and J-hook shall be provided on the opposite side of the pole shaft from the mast arm at the same elevation as the centre of the mast arm. A second 4" x 6.5" handhole with cover shall be provided at the pole base and located such that the ornamental base cover completely hides the hole.

- • **Connection Plate:**
  The mast arm connection plate shall be located 15 feet above the base of the pole. The connection plate shall have an upward angle of 18 degrees from the horizontal plan. See attached drawing.
- • **Ornamental Pole Top:**
  Each pole shall be provided with a removable ornamental pole top. The ornamental pole top shall be similar in appearance to the one shown on the attached drawing. The attachment mechanism for the ornamental pole top shall be capable of securely holding the pole top onto the pole shaft under the AASHTO wind loadings.

  There shall be three size categories of single arm mast arm poles: poles with 20 feet to 40-foot arms; poles with 42 feet to 50-foot arms; and poles with 52 feet to 60 foot arms. To achieve interchangeability between poles and foundations, all of the poles in a size

category shall have the same base plate size and bolt pattern.

There shall be three size categories of twin arm mast arm poles: poles with 20 feet to 40 foot arms; poles with 20 foot to 50 foot arms; and poles with 20 foot to 60 foot arms. To achieve interchangeability between poles and foundations, all of the poles in a size category shall have the same base plate size and bolt pattern.

Mast Arms:

Mast arms shall have an ornamental bend allowing the arm elevation to raise five (5) feet above the connection plate. Mast arms shall be round. Multi-sided and fluted mast arms are unacceptable. Mast arms shall have a constant linear taper of 0.14 inches per foot. The minimum thickness of steel shall be 7 gauge. Mast arms up to 40 foot in length shall be manufactured and shipped in one piece. Circumferential welded tube butt splices and laminated tubes are not permitted. Wire entrance holes 1-3/8 in diameter shall be drilled into the bottom of the arm every 11 feet starting at a point approximately 9 inches from the free

end of the arm. Rubber grommets shall be installed in the wire entrance holes. Each arm shall be provided with an ornamental end cap.

All arms shall be supplied with clamps to allow free swing mounting of signal heads. Enough clamps shall be supplied to allow signal heads to be mounted every 11 feet.

There shall be eight size categories of mast arms: 20-26-foot arms; 28-34 foot; 36-40 foot; 42-46 foot; 48-50 foot; 52-56 foot; 58-60 foot; and 62-66 foot. To achieve interchangeability between arms and poles, all of the arms in a size category shall have the same connection plate size and bolt pattern.

Ornamental Base Cover:

Poles shall be supplied with and ornamental base cover. The ornamental base shall be of the same general appearance as shown on the attached drawing. The ornamental base cover shall be a split base with twin doors at 180 degrees. The height of the base shall be 3'-9" and the bottom diameter shall be 2'-6".

Luminaire Arm:

Poles shall be supplied with an ornamental luminaire arm. The luminaire arm shall be a King Luminaire model KA30-S-XX Scroll Arm or equivalent. See the attached drawing for the general appearance. The arm shall extend six (6) feet from the pole shaft and have a 20-inch rise accomplished through a reverse curve. The luminaire arm shall have a decorative scroll which attaches to the pole shaft 36 inches below the luminaire arm attachment to the pole shaft. The decorative scroll shall attach to the luminaire arm at a tangent approximately in the middle of the arm. A decorative luminaire mounting shall be fastened to the end of the arm.

Construction

Work shall conform to details TS7-1.1 thru TS7-1.10, TS7-5 and the requirements specified under Section 700 of the VDOT's *Standard Specifications for Road and Bridge Construction (latest edition)*.

Measurement and Payment

Signal Poles shall be measured and paid for at the contract unit price per each. This shall include mast arms, flange plates, anchor plates, bolts, transformer bases, painting, welding, labour, and all other associated equipment and hardware required for installation.

Luminaire Arms shall be measured and paid for at the contract unit price per each. This shall include mounting, Led lamp, photocell, and all other associated equipment and hardware required for installation.

7.04: WOOD POLES General Description

It remains in this document as a matter of record, we do not anticipate any wooden poles under this contract. In case of removal or replacement all Wood Poles will Furnish and install Class II wood poles as specified in the contract documents or as directed by the ENGINEER.

Materials

ITEM
Wood Poles
Poles Conditioning

Pole Branding
Steel Span Wire
Steel Guy Rod (Single Thimble Eye)

STANDARD
ANSI 05.1 Latest Revisions
AWPA (American Wood-Preservers Association) Cl-79, latest Revision Pole Preservatives
AWPA P8 or AWPA P9. Latest Revision

AWPA M6, latest revision
950.12
Diameter min. 1/2”- 5/8” 3 Bolt Clamp

Wood Poles shall be Southern Pine, Treatment Group C (steam conditioned) or treatment Group D (kiln-drying).

Poles must be flat roofed.

Poles may be seasoned by air-seasoning, kiln-drying, steaming, heating in the preservative, or a combination of methods. Boulton drying is not permitted.

Shaving of all poles shall be full-length machine-shaved. The depth of cut shall not be more than necessary to remove inner bark.

There shall be no abrupt changes in the contour of the pole surface between the groundline and the aboveground sections.

The lower 2 ft of poles may be trimmed to remove wood fibers causing butt flare, provided sufficient sapwood remains to obtain the minimum penetration requirements.

The following defects are prohibited:

1. Cross Breaks (cracks)
2. Decay, except as permitted under "decayed knots"
3. Dead streaks
4. Holes, open or plugged, except holes for test purposes, which shall be plugged.
5. Hollow butts or tops, except as permitted under hollow pith centres and defective butts.

6. Nails, spikes, and other metal not specifically authorized by this specification. All other foreign material is prohibited.
7. Ring knots, A ring of knots consisting of four or more knots in a 3 in. section of the pole.

8. Bark knots. A knot that is under grown and partially encased with outer bark, in excess of 3 in. diameter.
9. Knot cluster. Two or more knots grouped together as a unit with the fibers of the wood deflected around the entire unit.
10. Decayed Knots -Type II "decayed Knots" where depth of decay exceeds 1/2 inches
11. Short Crook - A localized deviation from straightness which, within any section 5 feet or less in length, is more than 1/4 the mean diameter of the crooked section.
12. Pole Sweep. A straight line joining the surface of the pole at the top and ground line, shall not be separated from the surface of the pole by more than 1 inch for each ten feet of pole length.
13. Indentations, attributed to loading or handling slings, that are 1/4 in. or deeper over 20% or more of the pole circumference, or indentations which result from careless handling more than 1/2 in. deep at any point.
14. Spiral grain (twist grain) exceeds one complete twist in any 20 ft.

Pole Preservative Treatment

Poles may be heated in oil-type preservatives at atmospheric pressure to facilitate penetration of preservative.

Poles to be impregnated with the preservative by application of the standard empty cell (Rueping) process shall be performed in accordance with the standard "Poles - Preservative Treatment by Pressure Processes" (AWPA C4, latest revision).

No material other than poles shall be treated with poles.

The minimum net retention of Pentachlorophenol, as determined from 20 boring samples taken from any charge, shall not be less than the following.

Minimum Retention: Zone Assayed Retention

(lbs. Penta/cu. ft.) 0.5 - 2.0 in.
0.45

Retention of Pentachlorophenol shall be determined by AWPA A5, latest revision.

Construction

The following marking and code letter information shall be legibly and permanently burn branded with characters not less than 5/8 in. high. The markings shall be placed squarely on the face of the pole at 10 ft above the pole butt end and in the butt end of each pole in the following order.

1. Supplier's Brand
2. Plant Designation
3. Month and Year of Treatment
4. Code Letters; "SP" denoting Southern Pine and the preservative code,

   such as "P" for Pentachlorophenol in Petroleum (AWPA M-6).

5. Retention and Assay, such as "45-A"
6. Class and Length

Measurement and Payment

Class II wood poles shall be measured and paid for at the contract unit price each. The payment will be full compensation for the poles, anchors and guy rods all guy cables and connectors, labour, tools, materials, and incidentals necessary to complete this work.

7.05: SPAN WIRE General Description

Work shall consist of furnishing and installing steel span wire and tether wire as specified on the plans.

Materials

Steel Span Wire shall be A 475, Class C, 1⁄4 or 3/8 In. diameter and seven wire strand.

Construction

Work shall conform to details TS7-2 and TS7-3 and the requirements specified under Sections 700 and 703 of the VDOT's *Standard Specifications for Road and Bridge Construction (latest edition)*.

Measurement and Payment

Span Wire shall be measured in linear foot from connection point to connection point and paid for at the contract unit price per linear foot. This shall include thimbleye bolt assemblies, conductor cable supports, fittings, and all other incidentals required for installation.

Tether Wire shall be measured in linear foot from connection point to connection point and paid for at the contract unit price per linear foot. This shall include thimbleye bolt assemblies, fittings, and all other incidentals required for installation.

7.06: VEHICLE SIGNAL HEAD

All vehicle signal heads shall be the modular section type and shall be adjustable with respect to positioning and lens replacement. Heads shall be aluminium and yellow in colour and shall meet the requirements of the latest version of the ITE standard, "Vehicle Traffic Control Signal Heads". Unless otherwise indicated, traffic signal faces shall be LED. Refer to Section 7.08 for LED requirements.

Visors shall be the detachable cut-away type and have a yellow outer color. Visors shall be attached to the door assemblies in a manner that facilitates field removal and installation.

Signal heads shall not be installed with back plates.

Reflectors shall be silvered glass or Alzak aluminium type units. Sockets shall be fixed focus.

Doors on the signal heads for the installation of lamps and lens replacement or other maintenance shall not require use of any tool whatsoever to be opened. Doors and lenses shall be equipped with neoprene weatherproof gaskets to insure against infiltration of moisture, road film, and dust. Each three-color signal unit shall have the socket leads from all signal sections connected to a terminal board stamped with identifiable terminals. There shall be a terminal for colour indication plus a common terminal where one lead from each socket shall terminate. The terminal board shall be mounted in the middle section and be fully insulated. Gaskets shall be supplied for top and bottom openings.

Traffic signal heads shall be attached using standard ASTRO-BRAC Mast Arm Assembly or approved equivalent. Side of pole signal heads shall be installed with banding blocks and 90-degree elbows with nipple length determined by the size of the head so as not to interfere with closing doors.

Construction

Work shall conform to detail TS7-4 and the requirements specified under Section 703 of the VDOT's *Standard Specifications for Road and Bridge Construction (latest edition)*.

7.07: PEDESTRIAN SIGNAL HEAD General Description

Unless otherwise required, provide pedestrian signals and countdown pedestrian signals meeting the requirements of the ITE Standard for "Adjustable Face Pedestrian Signal Heads" and the "LED Performance Specifications of the Pedestrian Traffic Control Signal Indications (PTCSI)" Part 2, "Pedestrian Traffic Signal Modules."

LED pedestrian countdown module designed, as retrofit replacements for existing signal lamps, will not require special tools for installation.

LED countdown module will fit into a 16" x 18" traffic signal housing built to PTCSI Class 3 and 4 standards without modifications to the housing.

The nominal housing thickness (excluding power cord and power cord strain relief) will not be thicker than 3.0 inches.

The LED countdown module will be rated for use in the ambient operation temperature range of -40 degrees F to +165 degrees F.

The LED countdown module will be completely sealed against dust and moisture intrusion per the requirements of NEMA standard 250-1991 Sections 4.7.2.1 and 4.7.3.2 for Type 4 enclosures to protect all internal components.

Materials

The LED countdown module will be a single, self-contained device, not requiring on site assembly for installation into existing traffic signal housing.

The assembly of the LED countdown module will be designed to assure all internal components are adequately supported to withstand mechanical shock and vibration from high winds and other sources.

Three (3) secured, color-coded (blue, orange, white), 35 inches long, 18 AWG jacketed cable, are to be provided for electrical connections.

The yellow housing of the indication will be flame retardant plastic.

Display

The LED countdown module will consist of a double overlay message combining the graphic symbols of a hand and walking man and two (2) seven (7) segment digits.

In the graphic symbols, the LEDs will be arranged in a manner to form an outline. The shape of the outline will conform to the standard symbols for pedestrian signals.

The LEDs will be distributed evenly along the message outline. The hand/man symbols will be not less than 10-inch height and will be made of at least 63 high intensity LEDs for each one of the hand/man symbols in order to assure adequate luminous intensity.

The countdown digits will be 7 inch high and will be made of at least 72 LEDs.

The “Portland Orange” LEDs will be of the latest AllnGap technology and the white LEDs will be out of the latest InGaN technology.

The individual LED light sources will be interconnected so that a catastrophic failure of a single LED will result in a total loss off not more than 5% of the signal light output. The window will be masked flat black around graphic symbols and digits to optimize on/off contrast.

Drive Circuitry

The driver board will drive the LEDs at a DC current not exceeding the maximum rating recommended by the LED manufacturer.

The driver board will regulate the LED drive current on both hand/man messages to compensate for line voltage fluctuations over the range of 80 VAC to 135 VAC. The luminous output will not vary more than 10% over the voltage range and will not be perceptible to the human eye.

The circuitry will ensure compatibility and proper triggering and operation of load switches and conflict monitors in signal controllers currently in use by the procuring traffic authority.

Countdown Functionality

The LED countdown module will be compatible with all types of traffic controllers.

The countdown timer module will have a microprocessor capable of setting its own time when connected to a traffic controller.

When connected, the module will blank out the display during the initial two cycles while it records the countdown time using the Walk and D/Walk signal indications.

The countdown timer module will continuously monitor the traffic controller for any changes to the pedestrian phase time and re-program itself automatically if needed. Changes of time less than one count will be ignored.

The countdown module will register the time for the walk and clearance intervals individually and will begin counting down from the sum of both interval times.

When the walk interval is pre-empted, the countdown module will also pre-empt and skip directly to the clearance time and wait for the flashing hand to resume the countdown.

When in the flashing hand clearance phase, the digits will turn on and off in sync with the hand.

Warranty

The unit will be repaired or replaced by the manufacturer if it exhibits a failure to workmanship or material defects within the first 72 months of field operation.

The unit will be repaired or replaced by the manufacturer if, when operating over the specified operating ambient temperature and voltage ranges, the unit does not produce luminous intensity equal or greater than maintained minimum intensity levels set forth herein during the first 72 months of field operation.

Light emitting diode signal modules will meet or exceed the standard light output values specified in the luminous intensity table, after 72 months of continuous use over the temperature range provided in the specifications.

The measured chromaticity coordinates of light emitting diode signal modules will conform to the requirements of chromaticity in Figure 1 of the ITE VTCSH and the PTCSI over the temperature range provided in the specification for the duration of the warranty period.

The manufacturer will provide a written warranty against defects in materials and workmanship for LED signal modules for a period of 72 months after installation of LED signal modules. Replacement LED signal modules will be provided within 5 days after receipt of failed LED signal modules at no cost to the County, except the cost of shipping the failed modules.

Construction

Work shall conform to detail TS7-5 and the requirements specified under Sections 703 and 238 of the VDOT's *Standard Specifications for Road and Bridge Construction (latest edition)*.

Measurement and Payment

Vehicle Signal Head shall be measured and paid for at the contract unit price per each. This shall include mountings, moulded terminal blocks, visors, backplates, fittings, realignments, lamps and optical adjustments or LED modules as required.

Pedestrian Signal Head shall me measured and paid for at the contract unit price per each. This shall include mountings, LED indication modules, moulded terminal blocks, visors, fittings, and realignments.

7.08: LIGHT EMITTING DIODE (LED) VEHICLE TRAFFIC SIGNALS General Description

All traffic signal faces (vehicular and pedestrian) shall be LED type, unless otherwise specified by the COUNTY.

The LED traffic signal faces shall conform to the following requirements:

The LED optical units shall be installed in accordance with the manufacturer's instructions.

LED optical units shall meet or exceed ITE Adjustable Face Vehicular Traffic Control and Pedestrian Signal Head Standards.

Minimum Number of LEDs Per Optical Unit - The minimum number of LEDs per optical unit shall be as specified by the manufacturer to meet ITE luminance specifications for signal installation. No less than 125 LED’s per optical unit will be allowed.

The LED traffic signal lamps shall have a high number of LED’s.

Circuit Configuration - The LED’S shall be connected to form multiple series circuits. All series circuits shall be interconnected at intervals, forming sub-circuits not exceeding 15 LED’S for the red ball and arrow signals, and 10 LED’S for the pedestrian hand symbol. In the event of an LED failure, these sub-circuits shall limit the number of extinguished LED’S to no more than 5% of the total of all signals, vehicular and pedestrian. Contractor to replace at contractor’s expense if more than 5%.

Enclosure - Shall be dust and water-resistant
Operating Temperature - Between -40 degrees F and +185 degrees F.

Lens - Shall be replaceable, polycarbonate (UV stabilized "Lexan") convex lens; meet ITE colour standards; minimum of 1/8 inch thickness; and minimum light transmittance of 92%, free from bubbles, flaws and other imperfections. Non-polycarbonate red tinted lenses will be accepted provided that these meet ITE colour standards. Chromacity shall be measured uniform across the face of the lens. Non-polycarbonate lenses shall also meet 3-1/2-foot drop tests.

Candlepower Distribution - Shall meet minimum ITE specifications. Intensity shall be measured uniform across the face of the lens. Brightness shall be maintained in the event of voltage fluctuations or voltage drops.

Beam Spread 30 degrees to each side.

Warranty

The unit will be repaired or replaced by the manufacturer if it exhibits a failure to workmanship or material defects within the first 72 months of field operation.

The unit will be repaired or replaced by the manufacturer if, when operating over the specified operating ambient temperature and voltage ranges, the unit does not produce luminous intensity equal or greater than maintained minimum intensity levels set forth herein during the first 72 months of field operation.

Light emitting diode signal modules will meet or exceed the standard light output values specified in the luminous intensity table, after 72 months of continuous use over the temperature range provided in the specifications.

The measured chromaticity coordinates of light emitting diode signal modules will conform to the requirements of chromaticity in Figure 1 of the ITE VTCSH and the PTCSI over the temperature range provided in the specification for the duration of the warranty period.

The manufacturer will provide a written warranty against defects in materials and workmanship for LED signal modules for a period of 72 months after installation of LED signal modules. Replacement LED signal modules will be provided within 5 days after receipt of failed LED signal modules at no cost to the County, except the cost of shipping the failed modules.

Measurement and Payment

LED Modules shall be measured and paid for at the contract unit price per each. This shall include installation and internal electrical wiring as required.

7.09: CONTROLLER CABINET ASSEMBLY General Description

These specifications set forth the minimum requirements for a TS2 traffic control cabinet assembly. The cabinet assembly shall meet, as a minimum, all applicable sections of the NEMA Standard Publication No. TS2-2003.

All cabinets shall be Size-P, Type TS2 except for pedestrian HAWK signals (see page 87).

All new installations shall meet this specification. Legacy installations may meet TS1 requirements, as directed by the ENGINEER.

Operational Characteristics

The controller shall operate in two distinct modes based upon a user defined software setting. These modes are pre-timed and actuated.

Both operational modes shall provide for controller addressing by IP of MAC address.

The controller’s firmware shall be stored in non-volatile Flash RAM.

Both operational modes shall provide for data transfer via USB data drive. The USB data drive shall be of sufficient capacity to store complete data bases for all intersections. This data transfer shall be subject to the addressing scheme utilized by the controller and cabinet to ensure that the proper data is loaded to the controller. Data that is available for transfer in this manner will include:

1. Controller database
2. Controller event logs
3. Conflict monitor logs
4. Controller firmware updates

Datakey is not allowed.

Pre-timed Operation

The controller shall operate in pre-timed control operation as defined by TS 2-2003, Section 3.4 with the following:

All I/O shall operate across 1 or 1 BIUs to allow for operation in a CBD cabinet.

Actuated Operation

The controller shall operate in actuated control operation as defined by TS 2-2003, Section 3.4 with the following:

The controller shall provide for a minimum of 16 phases, 16 pedestrian and 8 overlaps.

MALFUNCTION MANAGEMENT UNIT

The Malfunction Management Unit shall meet, as a minimum, the requirements of Section 4 of the NEMA Standards Publication No. TS2-2003.

The Malfunction Management Unit shall be of type channel-16 LE.

Layout

The layout of the cabinet assembly shall conform to Section 5.2.7 of the NEMA Standards Publication No. TS2-2003.

1. The Communications Assembly shall be located on the left wall of the cabinet and shall be accessible without removal of any parts.
2. The tech panel shall be mounted on the inside of the cabinet door.

Controller Interface

The controller interface shall meet the requirements for a Type 1 interface as defined in Section 5.3 of the NEMA Standard Publication No. TS2-2003.

BIU Interface

1. The BIU interface shall meet the requirements of Section 5.3.1.4 of the NEMA Standard Publication No. TS2-2003.
2. The BIU rack design and signal pin assignment shall meet the requirements of Section 8 of NEMA Standard Publication No. TS2-2003.
3. Category 5e "Ethernet" data connection shall meet the following specifications: 44

1. Environmental
    - Ingress Protection: IP67 and IP66 (dust/water).
    - Corrosion: Resistant to most common chemicals, oils and cleaning agents.
    - Housing: UV resistant.
    - Housing Temperature Range: TIA/EIA-568-B.2 -25°C to 70°C.

2. Mechanical
    - Vibration:
        - – Frequency Range: 10-500Hz
        - – Acceleration: 5g (operational)
    - Mating Cycles: 750 minimum.
    - UL 1863 compliant.
3. Material
    - Housing: Valox®, UL 94V-0.
    - Noise Contacts: Beryllium copper with a minimum of 50 micro-inch Gold plating over nickel under plating.
    - IDC 110 Contacts: Phosphor bronze with 100 micro-inch tin lead 60/40 plating over nickel under plating.

4. Electrical
    - ANSI/TIA/EIA-568-B.2 (Category 5e).
    - Supports TIA-1005 Industrial Telecommunications Infrastructure Draft.
    - Supports IEEE 802.3af to 4 times the DTE Power specification.
    - Exceeds IEEE 802.3ab Gigabit specification to $< 1 * 10^{-13.}$

Port 1 Communications Cable

The port 1 communication cables shall meet the requirements of Section 5.3.3 of NEMA Standard Publication No. TS2-2003.

CABINET SWITCHES AND POLICE PANEL

Technician Switch

A technician switch panel shall be mounted on the inside of cabinet. The test switch panel shall provide as a minimum the following:

1. AUTO/FLASH SWITCH. When in the flash position, power shall be maintained to the controller and the intersection shall be placed in flash. The controller shall not be stop timed and the cyclic operation of the controller shall not be affected when this switch is in the flash position. When the switch is returned to the auto position the controller shall immediately initiate the start-up sequence.
2. STOP TIME SWITCH. When applied, the controller shall be stop timed in the current interval.
3. CONTROL EQUIPMENT POWER ON/OFF. This switch shall control the controller, conflict monitor, and cabinet power supply AC power.
4. PEDESTRIAN DETECTOR INPUT. On the technician switch panel, four momentary pedestrian detector input should be provided.
5.

Police Switch

The police door switch panel shall contain the following:

1. SIGNALS ON/OFF SWITCH. In the OFF position, power shall be removed from signal heads in the intersection. The controller shall continue to operate. When in the OFF position, the conflict monitor shall not conflict or require reset.
2. AUTO/FLASH SWITCH. In the flash position, power shall not be removed from the controller and stop time shall be applied. If required by the signal plans and specifications, an optional RC network shall be provided to give the controller an external start pulse when switch is returned to the auto position. This will force the controller to initiate the start-up sequence when exiting flash.
3. RJ-45 port – shall be installed with 6’ category 5E cable as shown in TS 7-18.

Generator Switch

The system shall be equipped with an external generator sensing/transfer switch and keyed generator cable receptacle. In the event an external 120VAC generator is connected to the system, the inverter shall qualify the power from the unit and if within parameters derive its input from the generator, thus providing uninterrupted power to the critical load and recharging the batteries. This transition shall be accomplished without any switching or coupling (other than the cable connection), and with no interruption of power to the critical load from either failure or restoration of generator AC power.

A generator access compartment with separate access door shall be mounted in the top third of the main door and shall be provided with a police key lock and 2 keys. A cable entryway shall be provided in the bottom of the door with a closure to fully seal the entryway when not used. A twist lock electrical connector shall be mounted to the rear wall within this compartment. This receptacle shall be a HBL-2315 or approved equal and shall have a full coverage boot over the entire rear portion of the unit. This unit shall mate with the generator plugs in use by the Agency. When the generator plug is connected to the receptacle, it shall be possible to safely close and lock the compartment door securing the system.

General

1. All toggle type switches shall be heavy duty and rated 15 amps minimum. Single- or double-pole switches may be provided, as required.
2. Any exposed terminals or switch solder points shall be covered with a non-flexible shield to prevent accidental contact.
3. All switch functions must be permanently and clearly labelled.
4. All wire routed to the police door-in-door and test switch push-button panel shall be

   adequately protected against damage from repetitive opening and closing of the main door.

Warranty

The CONTRACTOR shall provide materials with a manufacturer's warranty/guarantee, transferable to The County Department of Environmental Services, that the supplied materials will be free from all defects in materials and workmanship for the stated time period from the date of shipment. The CONTRACTOR shall supply the ENGINEER with any warranty/guarantee documents from the manufacturer and a copy of the invoice showing date of shipment.

Measurement and Payment

Controller Cabinet Assemblies shall be measured and paid for at the contract unit price per each. This shall include timing data, timing implementation, training, controller cabinets, back panels, power panels, detector panels, auxiliary panels, police panels, thermostatically controlled fan units in the cabinet with vent, flashers, local flasher switches, radio frequency interference filters, signal switches, main switches, police hand controls, conflict monitors, flasher relay assemblies, power relays, signal control assemblies, lamp receptacles and ground fault receptacles, circuit programs, flexible cables, grounding systems, transient protection devices, fittings, and all other associated equipment as required.

7.10: LED SIGNS BLANK-OUT SIGNS

Signs shall be square or rectangular weatherproof units. Only internal illumination shall be used. When illuminated, the message shall be white on an opaque background. The sign face or cover shall consist of a polycarbonate lens. The housing shall be sheet aluminium at least 0.125 inch in thickness finished with two coats of flat black paint.

The size and arrangement of letters forming the message shall conform to the requirements of the *Federal Standard Highway Signs Booklet* or an adaptation approved by the Engineer. When activated, the message shall be clearly readable at all times at a distance of 200 feet in all atmospheric conditions except dense fog. The message shall be controlled by a time clock or another type of actuation as specified on the plans. Signs shall illuminate instantly without a "warm-up" requirement or a continuously energized ballast. When signs are de-energized, the message shall not be readable.

ILLUMINTATED STREET NAME SIGNS General

1. The sign assembly standard widths are in 12” increments from 48” to 144”.

   Standard sizes are 48”, 72”, and 96”. The standard viewable heights are available to 28”, with standard sizes of 18”, 20”, 24”, and 28”. The overall thickness of the sign body shall be no more than 2-1/4” for single or 3” for double face designs.

2. The sign body shall be fabricated in accordance with NEMA 3R standards. Sign

   body shall be constructed of sheet aluminium 5052H32 with a thickness of .090. The sign body enclosure shall be continuously welded. The sign body shall be reinforced to allow for mounting hardware on the back and top of the sign. The sign body shall have (2) _” weep holes in the bottom to allow ex filtration of any moisture. Photocell, if required, will be external to sign.

3. The colour of the exterior of the sign assembly shall be semi-gloss black. All

   exterior surfaces of the sign assembly shall be powder-coat painted in accordance with Military Standard MIL-C-24712. Finish will meet the requirements of ASTM D 3359, ASTM D 3363, and ASTM D 552. A quality assurance program shall be in place, meeting MIL-1-45208A. Other standard colours are available.

4. Sign shall be UL listed and approved.
5. Sign shall be able to be hung via standard PELCO mounting hardware
6. The sign face shall be constructed of 1/8” white polycarbonate or clear polycarbonate with Diamond Grade reflective film and 3M EC film.
7. The sign shall have UL approved foam gaskets, to provide a watertight seal between the sign panel and the housing

7. (7a) The sign assembly including sign panel and mounting assemblies shall be designed, tested and constructed so that no permanent deformation, warping or failure will occur when subjected to 140 mph wind loads.
8. The sign shall include solid-state high flux/high output ultra-high brightness white LED light engineT8 bulbs (described in detail below), utilizing state-of-the-art high-power LED’s and high efficient heat dissipating panel. This LED light engine bulb shall be of adequate dimension to effectively uniformly light the sign face.
9. Edge lit sign shall be lit internally by installing (1) T8 LED bulb along the top edge and along the bottom edge. T8 LED bulbs will be (1) piece dimensioned to the length of the sign.
10. T8 LED bulbs shall be configured for either 120 v or 277 v and be able to lit and operated without the need for a ballast
11. T8 LED bulbs shall have internal access via a swing down door sign face, (1) side for single sided signs and (2) sides for double sided signs. The swing down doors shall have (2) lockable hasps fastened at the top of the sign.

LED T8 Light Engine Bulb

1. T8 LED Light Engine bulb shall be UL Listed
2. T8 LED Light Engine bulb shall be 120 v cool white, also available in 277v

3. The T8 LED Light Engine bulb shall not require a ballast
4. LED Light Engine shall be T8 LED tube design shall be one-piece available in 4', 6', and 8' lengths. Custom sizes also available. The LED light bulb is designed to simply plug into high output fluorescent sockets located in the upper and lower edge of sign.
5. LED Light Engine tube shall be designed as follows:
    1. T8 LED bulb120volts

        i. (6) foot – 28.5 watts power consumption / 1900 lumens

        ii. (8) foot – 38 watts power consumption / 2600 lumens

    2. T8 LED bulb 277 volts

        i. (6) foot - 26watts power consumption / 2145 lumens

ii. (8) foot – 32 watts power consumption / 2925 lumens

6. The T8 LED light engine bulb shall consist of adequate LED's to generate a surface luminance on average of a minimum of 200 lux over a –40o to +60oC ambient temperature range.
7. If anyone (1) LED should fail it will not cause any other LEDs to fail. 49

8. All T8 LED Light Engine bulbs shall be burned-in for 48 hours and certified for compliance by the manufacture.
9. Change of tubes within the sign shall not require any tools

Quality Assurance

1. **The LED Light Engine shall be manufactured in accordance with a vendor quality assurance (QA) program. The production QA shall include statistically controlled routine tests to ensure minimum performance levels of the LED Light Engine build to meet this specification.**
2. QA process and test result documentations shall be kept on file for a minimum period of seven (7) years.

Conformance

1. Any LED Light strip that does not satisfy the production QA testing performance requirements shall not be labelled, advertised, or sold as conforming to these specifications.

Warranty

1. LED Light Engines shall be replaced or repaired if they fail to function as intended due to workmanship or material defects within the first sixty (60) months from the date of delivery.
2. LED Light Engines that exhibit luminous intensities less than the minimum value within the first sixty (60) months from the date of delivery shall be replaced or repaired.
3. All LED street name signs shall be warranted for a period of (60) months from date of delivery.

.

7.11: PEDESTRIAN PUSHBUTTONS

MUSHROOM TYPE PUSHBUTTON

General Description

Work to furnish and install pedestrian push button assemblies and push-button signs as specified on the plans.

Materials

The push button assembly shall be weather-tight and tamper proof. The assembly shall be designed to prevent an electrical shock under any weather condition and have provisions for grounding in conformance with the NEC.

1. The push button assembly shall be fabricated from aluminium ingot and have an anodized finish.

2. The push button plunger shall be chrome plated, 2 in. diameter, and have a spring with operative force not to exceed 5 lb.
3. The push button switch shall have single-pole momentary, normally-open, single-throw contacts and spade-type terminals.
4. The switch assembly shall have an operating force approximately 0.5 lb, but not more than 1 lb.
5. The switch assembly shall be UL approved and electrically rated to carry 25 amps at 120 volts AC.

Construction

Locate push buttons in positions that clearly indicate to the pedestrian which crosswalks are actuated by each push button.

Work shall conform to detail TS7-7 and the requirements specified under Sections 700 and 703 of the VDOT's *Standard Specifications for Road and Bridge Construction (latest edition)*.

Measurement and Payment

Push button and push button signs shall be measured and paid for at the contract unit price per each. This shall include all material, labour, equipment, tools, and incidentals required for installation.

ACCESSIBLE PEDESTRIAN PUSHBUTTON STATION AND SIGNS

General Description

Where specified on the plans, accessible pedestrian pushbuttons shall be installed. The following describes the minimum requirements for providing accessible pedestrian pushbuttons and associated equipment:

Accessible Pedestrian Pushbutton Station and Signs and all component parts must be of Polara type and meet the latest edition of the National Electrical Manufacturers Association (NEMA) Standards and Underwriters Laboratory (UL), as applicable.

Serial numbers and model numbers, if available, shall be permanently engraved on all removable components and hardware. The serial number and model number shall be etched, stamped, moulded, or attached using metallic self-adhesive labels. The use of adhesive backed paper labels is not acceptable.

Accessible Pedestrian Pushbutton Station and Signs will be designed to mount near or at the bottom of the pedestrian display mounting post. The pushbutton assembly for the audible signal may replace or supplement an existing pedestrian signal pushbutton.

Accessible Pedestrian Pushbutton Station and Signs shall be designed to the following:

1. A single base unit at the traffic control cabinet must be able to control 2 to 12 (maximum of 3 per phase) push button stations.
2. 2 or 4 - conductor cable will be required from traffic controller cabinet per each pushbutton to operate all pushbutton features.
3. Each station will have a 2-in. button with a tactile raised directional arrow on the button.
    1. It shall be possible to change the arrow direction to one of four directions.
    2. Arrow/button shall vibrate during the walk period following a push of the button.
4. The push button station frame shall be cast aluminium with mounting holes for a 5 in. by 7.75 in. or larger pedestrian sign.

Accessible Pedestrian Pushbutton Station and Signs will have the following features:

1. Locating Tone
2. 5 walk sounds that shall be field selectable
3. 3 pedestrian clearance sound choices that shall field selectable
4. A direction of travel shall be standard with extended push
5. An information message shall be standard with extended push
6. Vibro-tactile walk phase indication

The audible sounds emitted by the Accessible Pedestrian Pushbutton Station and Signs and have the following properties:

1. All audible sounds shall emanate from the push button station
2. All audible sounds from push button stations shall be synchronized
3. Each audible feature shall have independently-adjustable minimum and maximum volume levels
4. All sounds shall automatically adjust over a 60-dB range to compensate for ambient

noise levels

5. All volumes and optional features shall be settable using a handheld infrared device

   with password security. The infrared device shall be capable of updating/setting all push button stations, or the intersection from a single pushbutton station (Global updating)

6. The ability to mute sounds at all crosswalks except activated crosswalks

Accessible Pedestrian Pushbutton Station and Signs systems shall meet the following requirements:

1. The system shall have user-selectable multiple language capabilities

2. The system shall be able to play an emergency pre-emption message
3. The system shall be able to self-test its buttons and to report and any faults to the

   traffic controller

Message Requirements:

Audible messages shall conform to the 2009 MUTCD Rev. 2 Section 4E and the following:

1. If speech walk messages are used to communicate the walk interval, they shall provide a clear message that the walk interval is in effect, as well as to which crossing it applies. Speech walk messages shall be used only at intersections where it is technically infeasible to install two accessible pedestrian signals at one corner separated by a distance of at least 10 feet.

   Speech walk messages that are used at intersections having pedestrian phasing that is concurrent with vehicular phasing shall be patterned after the model: “Broadway. Walk sign is on to cross Broadway at 1st.”

   Speech walk messages that are used at intersections having exclusive pedestrian phasing shall be patterned after the model: “Walk sign is on for all crossings.”

   Speech walk messages shall not contain any additional information, except they shall include designations such as “Street” or “Avenue” where this information is necessary to avoid ambiguity at a particular location.

   Vibro-tactile walk phase indication shall be triggered during each walk indication.

2. Following the audible walk indication, accessible pedestrian signals shall announce the pedestrian change interval countdown, “10, 9, 8... etc.”.
3. A speech walk message is not required at times when the walk interval is not active, but, if provided:

It shall begin with the term "wait." Speech wait messages shall be patterned after the model: "Wait to cross Broadway at 1st. Wait."

It need not be repeated for the entire time that the walk interval is not active; however, each push of the button shall be accompanied by the speech message patterned above.

Warranty

The pushbutton will be warranted for five (5) years from the date of shipment from the factory. For warranty repairs or replacement, the manufacturer shall guarantee product return within 10 business days from the date of shipment from The County.

Construction

Locate push buttons in positions that clearly indicate to the pedestrian which crosswalks are actuated by each push button.

Work shall conform to detail TS7-6.1 and the requirements specified under Sections 700 and 703 of the VDOT's *Standard Specifications for Road and Bridge Construction (latest edition)*.

Programming of the pushbutton shall conform to details TS7-6.4a & b.

ECONFIG – EZCOMMUNICATOR NAVIGATOR CONFIGURATOR

General Description

The EZCommunicator Navigator Configurator (ECONFIG) is a handheld remote used for configuring a Navigator 2 Wire system or individual 4 Wire Navigator push Button Stations (PBS). The configurator communicates via infrared with the PBS (and CCU of 2 Wire system). The EConfig is compatible with the N2 and N4 Navigator systems. All of the configuration options in the CCU and PBS are set with the Configurator. After configuring the features, you want, you can upload your choices to an individual PBS or to all of the PBSs on an entire intersection with a single button push. The EConfig also has the capability of saving 4 user defined configuration sets and has 3-factory default configuration sets. (Access is password protected to prevent unauthorized changes.)

EZCommunicator Navigator Configurator shall meet the following specifications:

1. Display: 2 Line x 16 Character; LCD with backlight, adjustable contrast
2. Power: 4 x AA 1.5v Cell, Low battery warning; Auto or Manual Shut-off
3. Color Case: Grey
4. Operating temp: 0°C to 50°C

Warranty

The EZCommunicator will be warranted for five (5) years from the date of shipment from the factory. For warranty repairs or replacement, the manufacturer shall guarantee product return within 10 business days from the date of shipment from The County.

Construction

EZCommunicator shall be delivered to The County prior to final acceptance of installation of Polara Pushbutton.

Work shall conform to detail TS7-6.2 and the requirements specified under Section 700 of the VDOT's *Standard Specifications for Road and Bridge Construction (latest edition)*.

CCU2EN – EZCOMMUNICATOR CENTRAL CONTROL UNIT W/ ETHERNET

General Description

The CCU2EN is to be installed inside the Traffic Cabinet and is powered by the AC supply mains (115 VAC). The CCU2EN is the power supply and signalling interface between the existing intersection Traffic Control Unit and Navigator Push Button stations (PBS) which are located in the field. One CCU2EN can control up to 16 EN2 Push button Stations, 4 maximum per channel. The CCU2EN controls up to four Pedestrian Channels, receiving its timing from the Walk and Don't Walk signals. Additional advanced configurations can be obtained by utilizing its general-purpose inputs. All inputs and outputs have full optical isolation and include voltage protection.

The CCU2EN has two built in conflict monitoring systems. The CCU2EN monitors the PBS and Ped-Head lights and powers off the channel upon a conflict. Each processor monitors each other and resets the CCU2EN upon loss of internal Communication.

The CCU2EN is backward compatible with older 2-Wire Navigator N2 PBSs (v1.12 or newer). There is an option switch on the back of the CCU2EN which specifies N2 or EN2. If all PBSs are EN2 PBSs, the EN2 position is used. If any of the PBSs are older 2-Wire N2 PBSs then the N2 position must be used.

The Ethernet port adds a connection to an on-board web server which provides information on PBS status, Event Log and remote Configuration of EN2 PBS options.

EZCommunicator Central Control Unit with Ethernet shall meet the following specifications:

1. Ped Walk/Don't Walk Inputs: Optically isolated 80 – 150 Volts AC/DC, 5mA max.
2. Ped Outputs: Optically Isolated 36 Volts Ac/DC peak; 300mA Solid State Fused Contact Closures.
3. Fault Output: Normally Open Relay Contacts 125 Volts AC/DC, 1A max.
4. A, B, C, D PBS Power Output: Nominal 18-22 Volts DC, Short Circuit Protected – Auto Recovering.
5. General Purpose Inputs: 10-36 Volts AC/DC peak, 10mA max, optically isolated.
6. Environmental:

Operating: -34°C (-30°F) to +74°C (+165°F) Storage: -45°C (-50°F) to +85°C (+184°F)

Warranty

The EZCommunicator will be warranted for five (5) years from the date of shipment from the factory. For warranty repairs or replacement, the manufacturer shall guarantee product return within 10 business days from the date of shipment from The County.

Construction

EZCommunicator shall be installed inside of the traffic signal cabinet.

Work shall conform to detail TS7-6.3 and the requirements specified under Sections 700 and 703 of the VDOT's *Standard Specifications for Road and Bridge Construction (latest edition)*.

Measurement and Payment

Accessible Pedestrian Pushbutton Station and Signs will be measured and paid for at the contract unit price each. The payment will be full compensation for furnishing, programming, delivery to the specified signal shop for testing, pick up, and installing the push button stations, signs, all cables, labour, equipment, tools, and incidentals necessary to complete this work.

Accessible Pedestrian 2 or 4-wire Central Control Unit will be measured and paid for at the contract unit price per each. The payment will be full compensation for furnishing, programming delivery to the specified signal shop for testing, pick up, and installing the Audible/Tactile Pedestrian Base unit and all cables, labour, equipment, tools, and incidentals necessary to complete this work.

7. 12:

ECONFIG – EZCommunicator Navigator Configurator will be measured and paid for at the contract unit price each. The payment will be full compensation for furnishing, programming, delivery to the specified signal shop for testing, pick up, and installing the push button stations, signs, all cables, labor, equipment, tools, and incidentals necessary to complete this work.

CCU2EN – EZCommunicator Central Control Unit with Ethernet will be measured and paid for at the contract unit price each. The payment will be full compensation for furnishing, programming, delivery to the specified signal shop for testing, pick up, and installing the push button stations, signs, all cables, labour, equipment, tools, and incidentals necessary to complete this work.

DETECTION

LOOP / MICRO LOOP DETECTION

Each individual loop or micro loop is to be terminated and splice within a side-of-road junction box as specified on the standard details. Each loop shall consist of one continuous wire, without splicing, to this termination point, and each micro loop detector shall include two continuous wires, without splicing, to this termination point. Each loop or micro loop shall have its own dedicated lead in pair (of wires) to the cabinet from the side of road junction box. Detector lead-in wire shall be continuous from the controller to the side-of-road junction box.

All detectors shall have a color-coded tag attached to the lead-in to indicate the relative location and the direction served by the detector.

Loop sealant is to be used in all saw cuts whether or not the roadway is to be overlaid. See standard details.

Detection Amplifiers shall be supplied for loop detectors (max. 4 channels). Micro loop detectors shall be 3M Canoga M701.

Lead-in cable shall be 3M Canoga Model 30003, and of a sufficient length to reach the junction box behind the curb.

Construction

Work shall conform to details TS7-8, TS7-9, TS7-10.1 and TS7-10.2 and the requirements specified under Section 703 of the VDOT's *Standard Specifications for Road and Bridge Construction (latest edition)*.

Measurement and Payment

Saw Cuts will be measured and paid for at the contract unit price per linear foot (lf). This price shall include cutting, cleaning, drilling, disposing of surplus material, backer rods, and loop sealant.

Detector Amplifiers shall be measured and paid for at the contract unit price per each. This shall include all internal electrical wiring and fittings.

STEREO-VISION PEDESTRIAN DETECTOR

1. The system shall be a stereovision video detection sensor that detects pedestrians waiting to cross the street and pedestrians approaching the crossing. It generates a detection output to the traffic signal/midblock beacon controller whenever one or more pedestrians are waiting or approaching (moving in the direction of the crossing) in the predefined virtual pedestrian detection zone.
2. For the purpose of this specification, a minimum sized person is defined as having a height greater than or equal to 1 meter (3.281 ft.), width 0.5 meter (1.64 ft.), depth 0.2 meter (.66 ft.), mass of 20 Kg (44 lbs). This also includes a person seated in a wheelchair, baby stroller, cyclists and mounted riders. The detection criterion applies irrespective of how pedestrians are dressed, in all weathers and at all times of day or night.

3. The system shall be configured to ignore pedestrians that are not waiting and pedestrians that are not walking towards the pedestrian crossing, coming from the opposite direction.
4. The system shall be non-intrusive (i.e. above ground) and consists of 2 CMOS digital cameras for stereovision, an embedded video detection processer with video detection software, and mounting bracket with integrated connection box. The camera and video detection processor are integrated in a single housing. A separate processor will not be required in the control cabinet.
5. In a user defined virtual detection zone, the stereovision detection software shall detect pedestrians moving and/or waiting at the curbside or approaching the pedestrian crossing in a maximum zone of 13' x 19' when mounted 11.5' to 13' above the street's surface.
6. The housing shall be compact, esthetical, UV-resistant and waterproof to IP68. It has an integrated rain/sun shield and is made of fiber reinforced polycarbonate.
7. The mounting bracket should allow horizontal and vertical mounting. To attach the sensor to a traffic light pole, 2 bolts or 2 stainless steel bands shall be used.
8. The cameras are a 1/4" CMOS with a resolution of 640x480 pixels (VGA). The frame rate is 25 FPS.
9. The video detection module inside the detector shall provide an optically coupled dry contact detection output for the traffic signal/midblock beacon controller (Umax=48VDC, Imax=50mA, Pmax=300mW). A red detection LED shall be clearly visible from the ground and allows both the pedestrian(s) and maintenance personnel to see the video detection module status (detection, no detection, safe status). This LED can be switched off. Via Ethernet - MPEG-4, compressed streaming video shall be available for setup and monitoring. The video detection module shall be IP-addressable and operates at voltages of 12-48VDC and 24-30VAC. The power consumption shall not exceed 3W during regular operations.

10. A single Cat5e (rated for outdoor use) cable connects the detection module with the traffic signal/midblock beacon controller cabinet and is used for power supply, detection output generation and communications. Maximum distance for Ethernet cable is 300'.
11. The total mass of the pedestrian detection system (incl. mounting bracket, excl. cabling) will be less than 2.2lbs.
12. The system shall have an Ethernet connection to communicate with a portable PC. The configuration of the system is done with software on a portable PC. The program can run on Windows XP/Vista/7. The program is user-friendly and uses the camera image (JPEG snapshot) or video stream to place the virtual pedestrian detection zone on the curbside's surface in a simple and accurate way. This zone can be made direction sensitive in any one single direction. The MPEG-4 streaming video can be used for viewing the detection. The configuration can be changed without disrupting normal operation.
13. It shall be possible to view, record and playback video sequences with dedicated software (e.g. VLC media player) that can be installed on a portable PC. Using application software provided by the supplier, remote management and viewing shall be capable via a direct connection to the sensors via Ethernet.
14. The mean time between failure (MTBF) or lifetime expectancy of the video detection module, mounting bracket and interface is a minimum 100,000 hours. The mean time to repair is less than 15 minutes, once a technician and the necessary equipment are on site.

15. Assuming a good camera positioning, zone positioning, zone size and no optical occlusion, the system shall detect waiting and approaching pedestrians with ≥98% accuracy under normal weather conditions, both day and night (when the illumination level on the ground exceeds 10 LUX). In extreme weather (e.g. dense fog, heavy snow), the video detection module must be able to switch to a safe status (i.e. permanent detection) until regular operations can be continued.
16. The pedestrian sensor shall have the ability to connect to an APS pushbutton station at the pole without any special wiring in the cabinet to activate the "Wait" (APS Acknowledgement) and "Walk" messages.
17. The pedestrian sensor shall have a three (3) year manufactures warranty.

THERMAL TRAFFIC DETECTION CAMERA Functional Description:

1. The Thermal Traffic Camera shall not depend on any visible or invisible (infrared) illumination or image intensifier to "see" i.e. produce images. The Thermal Traffic Camera shall be totally passive and not produce any energy or emit light any bandwidth. The Thermal Traffic Camera shall allow the user to clearly identify images in the total absence of light.
2. The Thermal Traffic Camera shall allow the user to see through smoke and light fog and to view the thermal patterns and contrast in the scene.
3. The Thermal Traffic Camera shall utilize a Vanadium Oxide (VOx) uncooled microbolometer responding in the LWIR (Long Wave Infrared) spectral range of 7.5 – 13.5 µm, which is beyond what is visible to the human eye.
4. The Thermal Traffic Camera shall be based on Vanadium Oxide (VOx) microbolometer detector technology and shall not be susceptible to permanent damage after imaging the sun. This is in contrast to some systems based on amorphous silicon detector technology, which can be permanently damaged when viewing the sun or even reflections of the sun.
5. The Thermal Traffic Camera shall not utilize shutters to prevent damage from the sun, but rather the Thermal Traffic Camera shall provide uninterrupted video which shall be required for traffic and ITS installations.
6. The Thermal Traffic Camera shall not utilize dynamic apertures to protect image sensor because these mechanisms reduce sensitivity for an extended period of time, thus reducing the Thermal Traffic Camera performance, which shall not be acceptable for traffic installations.
7. The Thermal Traffic Camera shall provide athermal optics that automatically adjust to background thermal changes, and therefore do not require re-adjustment and/or thermal refocusing.
8. The Thermal Traffic Camera shall not be susceptible to "image blooming" caused by bright lights as are image intensifiers and visible spectrum cameras.
9. The camera shall be factory configured with the following fixed anti-reflection coated Germanium lenses with the Field of View (FOV) and resolutions as indicated:
10. The noise Equivalent Temperature Difference (NETD) is the measure of the smallest 60 object temperature that can be detected by the thermal image sensor relative to the

system noise. The measurement is usually quantified as a mK value. This is the most common Figure of Merit of a thermal imaging system and a true measurement of the thermal camera's sensitivity. The Thermal Traffic Camera image sensor shall provide a NETD of <75mk, <50mK f/1.0 or lower.

Device	Lens	Resolution (pixels)	FOV
FC-334T	13 mm	320 x 240	34° H x 28° V
FC-324T	19 mm	320 x 240	28° H x 18° V
FC-348T	9 mm	320 x 240	48° H x 37° V

11. The Thermal Traffic Camera shall include Auto Digital Detail Enhancement (Auto DDE) which is an advanced non-linear image processing algorithm. The Auto DDE function is fully automatic and requires no input or adjustment from the user. The Auto DDE shall enhance the image detail to match the total dynamic range of the original image allowing details to be visible to the user even in schemed with low or high thermal contrast images. These settings shall be optimized for performance with Traffic Video Detection.
12. The Thermal Traffic Camera shall utilize Non-Uniformity Correction (NUC) which is set of compensation factors for each pixel. NUC shall enable the following features and benefits:
    1. Eliminate the need for FPA (Focal Plane Array) temperature stabilization.
    2. Allow for near instantaneous camera turn-on.
    3. Reduce system complexity and power consumption.
    4. Allow for a wider operating temperature range.
13. The Thermal Traffic Camera shall include Automatic Gain Control (AGC) circuitry to compensate for scene variations, improve image quality by avoiding saturation and distortion, and to balance signal levels prior to display to maximize image quality.
14. The Thermal Traffic Camera shall feature both White-Hot and Black-Hot operating modes. In the White-Hot (default) mode warmer objects will be displayed in white and lighter shades than cooler or background areas. In the Black-Hot mode warmer images will be displayed as black or dark grey as compared to cooler background objects.
15. The Thermal Traffic Camera shall provide standard NTSC or PAL analog composite video output (factory configured to allow it to function as a direct replacement for daylight camera and to connect directly to industry standard video detection software cards and recording devices. The analog video signal shall be available via BOTH and BNC video output connector and a connector free terminal block. The video outputs shall be surge protected.
16. The Thermal Traffic Camera shall be furnished in an IP-66 rated outdoor enclosure with sunshield and mounting base. The mounting base shall be provided with 1/4x20 holes for mounting to a pedestal or wall mount. All cable connections shall be made inside of the enclosure. The enclosure shall be provided with liquid-tight sealed cable gland fittings for the video and power cables.
17. 17. The camera enclosures shall include grounding and surge protection. A separate Earth ground connection shall be made inside the enclosure to a designated grounding lug. The Earth ground conductor may be run as part of the power cable bundle.

18. 18. Then Thermal Traffic Camera shall operate on surge protected 110/220 VAC.
19. 19. The Thermal Traffic Camera shall include a 10-year warranty on the thermal detector.
20. 20. The Thermal Traffic Camera shall be a FLIR FC Series Traffic Camera. Acceptable Models: FC-324T, FC-334T, FC-348T.

Camera Specifications:

The Thermal Traffic Camera shall meet the following minimum requirements:

Sensor Type:
Spectral Response: Sensitivity (Thermal Camera Sensor):
Pixel Pitch:
Video Output:
Input Voltage:
Power Consumption: Operating Temperature

Range:

Storage Temperature Range:
NEMA TS 2:

Enclosure Rating: Weight: Dimensions:

Long-life VOx Uncooled Microbolometer w/10-year warranty. 7.5 to 13.5µm

<75mk, <50mK f/1.0
25 microns
Dual NTSC or PAL (BNC and Connector Free) 90-240VAC Single Phase 50-60hz 90-240VAC: 1.7W w/110VAC

-50°C to 75°C (Continuous Operation) -40°C to 75°C (Cold Start)

-55°C to 85°C
Environmental testing for FC Series was conducted by IAW w/ Section 2.1 of MEMA TS 2-2003 and either meets or exceeds those requirements in the following categories: Operating Voltage, Operating Frequency, Ambient Temperature, Humidity, Vibration and Shock.
IP-66
4.2 lb w/sun shield.
10.8” x 5.4” x 4.4” (w/sun shield)

The Thermal Traffic
334T, FC-348T, or FC-324T.

Camera shall be a FLIR FC-Series Traffic Camera. Model FC-

Warranty

The supplier shall provide a limited two-year warranty on the Thermal Traffic Detection Camera. See suppliers standard warranty included in the Terms and Conditions of Sale documentation.

During the warranty period, technical support shall be provided from the supplier via telephone within 4 hours of the time a call is made by a user, and this support shall be available from factory-certified installers.

Updates to Thermal Traffic Detection Camera software shall be available from the supplier without charge.

Measurement and Payment

Thermal Traffic Detection camera shall be measured and paid for at the contract unit price per each. This shall include all associated equipment required for proper installation.

Thermal camera lead-in cables shall be measured and paid for at the contract unit price per linear foot (lf).

Thermal camera interface equipment shall be measured and paid for at the contract unit price per each. This shall include internal wiring and installation as required.

Construction

Mounting locations shall conform to detail TS7-16 and the requirements specified under Sections 700 and 703 of the VDOT's *Standard Specifications for Road and Bridge Construction (latest edition)*.

VIDEO DETECTION

General Description:

Where specified on the plans, video detection shall be installed. The following describes the minimum requirements for providing a complete Video Detection System. Initially, the system shall be capable of providing presence vehicle detection at selected intersections. The video system shall be expandable without removing or replacing existing units.

Acceptable systems include that of any manufacturer, provided such equipment meets all qualifying specifications identified herein. Using standard image sensor optics and in the absence of occlusion, the system shall be able to detect vehicle presence with 98% accuracy under normal conditions (days and nights), and 96% accuracy under adverse conditions (fog, rain, snow).

All items and materials furnished shall be new, unused, current production models installed and operational in a user environment and shall be items currently in distribution. The products algorithms shall have a proven record of field use at other installations for at least two (2) years of service i.e., not including prototype field trials prior to installation.

Video Vehicle Detection System:

These technical specifications describe the minimum physical and functional properties of a video detection system. The system shall be capable of monitoring all licensed vehicles on the roadway, providing video detection for areas outlined in the construction drawings. The entire video detection system shall consist of the following:

1. Video Image processing unit(s)
2. Thermal or video Camera(s) with lens of choice, IR filter, enclosure, and sunshield
3. TIP Communication Module
4. Surge Suppressor
5. All other necessary equipment for operation

Video Image Processing Unit Specifications Software Specifications:

1. The Video Image Processing Unit shall fit directly into the 170 and NEMA racks without an interface box. The unit shall be capable of monitoring one or two (2) separate cameras. Video inputs to the unit shall enter through the input file or detector rack edge connector. The Video Image Processing Unit shall be located on one module, daughter PC cards connected through ribbon cables shall not be allowed.
2. On each camera the presence is detected on 24 zones. Counting data can be stored for up to 6 different lanes. The up to 4000 records stored on board can be retrieved via a RS232 port on the front. All probes (24 for two cameras) can be combined in different relationships (AND, OR, NOT) to 24 outputs. 20 digital inputs allow to expand the conditional output with external equipment. Also conditional count is possible.
3. All probes and parameters can be changed without stopping the detection. For example: when one probe is modified all probes continue to work, including the one that is being modified. When the new position is confirmed, the new probe will enter a learning phase. Once the new probe is in function it will take over the job of the old one. In this way, the detector is always full operational with no interrupt on any probe, even during modification.
4. Four detector configurations can be stored on board. Software download from PC via serial port is possible.

General Specifications:

1. 1 or 2 camera inputs, 24 digital outputs, 20 digital inputs
2. Fits direct into the 170 and NEMA rack without additional adapter
3. 24 direction sensible detector probes per camera, including up to 6 counting probes per camera
4. Stores counts for 4000 intervals.
5. Detection results of all detection probes can be combined with the inputs to the related outputs. AND, OR, NOT
6. 4 configurations stored on board
7. Modifications with no interruption on all probes
8. Setup via keypad and monitor (no pointing device needed)
9. Software update via RS232

Video Detection Board:

1. The video detection board will have only 4 outputs and will use expansion boards for additional input and output.

2. The video detection (Main) board will have the following on the front:
    1. One Male DB9 for connection with the first expansion board.
    2. One Female DB9 for setup with keypad (Service port)
    3. LEDs for outputs on board (2 for cam 1 and 2 for camera 2), power, Video Cam 1 and Video Cam2, Communication with expansions
    4. One video output for setup via keypad
    5. A switch to select which image to be on the service output

I/O Expansion Board:

3. The input/output expansion board will have the following on the front:

1. LED's for power, Expansion communication, In/output activity
2. 2 DB9 ports for communication with Master or other expansion boards
3. A 8-dipswitch device to select the following:
    ii. Input or Output
    iii. Range: 1-12 or 13-24
    iv. Input or Output number (see example for more info)

PIN Usage on 170

1. Video Detection (Main) board. The master is 2 slots wide. There are 4 outputs free selectable over the 2 cameras. The master cannot have inputs.

The master has a DB9 connector to be connected to the first slave (Exp Comm IN). The first slave (Exp Comm OUT) is then connected to the second one. DB9 means you can use flat or round cables.

	TB2	**TB1**
SP	1. SPARE	1.SPARE
F	2. DET.#1 Out	2. DET.#2 Out
W	3. DET.#3 Out	3. DET.#4 Out
D	4. VIDEO #1 IN (+)	4. VIDEO #2 IN (+)
E	5. VIDEO #1 IN (-)	5. VIDEO #2 IN (-)
J	6. VIDEO OUT (+)	6. RS485 (+)
K	7. VIDEO OUT (-)	7. RS485 (-)
L	8. EQ GND	8. EQ GND

Input file connector	**Function**
A	DC-GND
B	+ 24 VDC
C	Not USED

D	VIDEO #1 IN (+)
E	VIDEO #1 IN (-)
F	DET #1 OUTPUT
H	LOGIC GROUND
J	VIDEO OUT (+)
K	VIDEO OUT (-)
L	EQUIPMENT GROUND
M	AC -
N	AC +
P	VIDEO #1 IN (+)
R	VIDEO #1 IN (-)
S	DET #2 OUTPUT
T	LOGIC GROUND
U	RS485 (+)
V	RS485 (-)
W	DET #3 OUTPUT
X	LOGIC GROUND
Y	DET #4 OUTPUT
Z	LOGIC GROUND

i. The input/output expansion board. The slave card is only 1 slot wide. You can use 2 or 4 in/outputs. Using the dip-switches one can select which output (defined in the VIP3) will be connected on the expansion board.

	TB2	**TB1**
SP	1. SPARE	1.SPARE
F	2. DET.#A In / Out	2. DET.#C In / Out
W	3. DET.#B In / Out	3. DET.#D In / Out
D	4. NC	4. NC
E	5. NC	5. NC
J	6. NC	6. NC
K	7. NC	7. NC
L	8. EQ GND	8. EQ GND

Input file connector	**Function**
A	DC-GND
B	+ 24 VDC
C	Not USED
D	Not USED

E	Not USED
F	DET #A INPUT / OUTPUT
H	LOGIC GROUND
J	Not USED
K	Not USED
L	EQUIPMENT GROUND
M	AC -
N	AC +
P	Not USED
R	Not USED
S	DET #C INPUT / OUTPUT
T	LOGIC GROUND
U	Not USED
V	Not USED
W	DET #B INPUT / OUTPUT
X	LOGIC GROUND
Y	DET #D INPUT / OUTPUT
Z	LOGIC GROUND

Colour Video Camera:

The unit shall be a high resolution, 1/3 image format CCD camera, designed for professional video surveillance systems. Incorporating the latest in CCD technology, the video camera shall provide detailed video without lag, image retention, or geometric distortion. The unit shall output color video.

• • • • • • •

Temperature range Humidity Dimensions Weight

Camera mounting slots Connectors
Lens mount

-20 to + 55 degrees C
0% to 95% relative, non-condensing 152mm X 64mm X 54mm
0.7kg
1/4-20, top and bottom
BNC for video out
CS
Power-in / pressure screw
Lens / 6-pin miniature “DIN” style Off-white semi-gloss polyurethane

- Finish
- Construction

Warranty

The supplier shall provide a limited two-year warranty on the video detection system. See suppliers standard warranty included in the Terms and Conditions of Sale documentation.

During the warranty period, technical support shall be provided from the supplier via telephone within 4 hours of the time a call is made by a user, and this support shall be available from factory-certified installers.

Updates to video detection software shall be available from the supplier without charge.

Measurement and Payment

Video camera shall be measured and paid for at the contract unit price per each. This shall include all associated equipment required for proper installation.

Video camera lead-in cables shall be measured and paid for at the contract unit price per linear foot (lf).

Video camera interface equipment shall be measured and paid for at the contract unit price per each. This shall include internal wiring and installation as required.

Construction

Mounting locations shall conform to detail TS7-16 and the requirements specified under Sections 700 and 703 of the VDOT's *Standard Specifications for Road and Bridge Construction (latest edition)*.

TIP COMMUNICATION MODULE

1. The TIP COMMUNICATIONS MODULE shall include a standalone video rack with Internal Power Supply, AC Plug, and Wiring Harness.
2. The TIP COMMUNICATIONS MODULE shall control from 1 to 4 TIP boards allowing for 1 to 8 sensors.
3. The TIP COMMUNICATIONS MODULE shall provide a 3.5mmstereo jack port (for programming keypad) and Ethernet interface and communication to provide traffic data and allow remote configuration from the Traffic Operations Center.
4. The LAN port shall meet IEEE 802.3 with a RJ-45 connector and meet the following specification:

   a. Data rates for Ethernet via LAN port: 10/100Mbps a. TCP/IP based protocol

5. The communication shall support all functions of the thermal detection system.
6. All data transmissions shall be protected by CRC (cyclic redundancy checking) or an equivalent error detection method.
7. The communication board shall be programmed without the use of a supervisor computer. A standard CCTV monitor and keypad plugged into the communication serial port will facilitate board programming.
8. The communication shall support H.264/MPEG-4/MJPEG dual streaming thermal over Ethernet with the following programmable parameters:

a.

Dual Thermal Encoder selection (per thermal encoder):

1. Thermal encoding: H.264, MPEG-4 or MJPEG
2. Views: Single, Quad, PiP (Picture in Picture) and Compass View
3. Frame rate programmable from 1 to 30 frames/second
4. Programmable bit/data rate of up to 8 Mbps
5. Resolutions: Full D1, VGA, QVGA, CIF, QCIF

b. Thermal Stream:

1. Network Protocol: RTP/UDP, IP unicast or multicast IPV4
2. Transport Protocol: RTSP over TCP
3. Supported players: ThermalLAN VLC, Apple©Quicktime

9. Password protected remote setup (configuration upload/download, setup of detectors and detector parameters, setup of communication board parameters, firmware updates for Communication and TIP module) and monitoring of every connected TIP module shall be possible.
10. The TIP COMMUNICATIONS MODULE shall log traffic data and events provided by the TIP module(s) and transmit data and events to the HOST computer.
11. The TIP COMMUNICATIONS MODULE shall send the traffic data from the TIP boards at a programmable interval from 10 seconds to 60 minutes.

12.RS485 communication to every TIP card shall be established via the Edge connector.

13. A (via Ethernet) connection with any standard Internet browser shall be possible to communicate with the TIP COMMUNICATIONS MODULE for remote set-up, monitoring and real-time traffic data (count, speed, occupancy) of the TIP modules.
14. Password protection shall be provided on the TIP COMMUNICATIONS MODULE for remote operations.

15. Remote TIP COMMUNICATIONS MODULE and TIP firmware upgrades shall be possible via Ethernet communication.
16. The TIP COMMUNICATIONS MODULE supports SNMP management per RFC 1213.
17. The TIP COMMUNICATIONS MODULE shall have the option to connect to an NTP server for date and time synchronization where available.
18. If no NTP server is available, the user shall be able to remotely send a time synchronization via the TIP COMMUNICATIONS MODULE web-server page. This will synchronize date and time to the communication modules and also the TIP connected boards automatically.
19. The TIP COMMUNICATIONS MODULE shall have a three (3) year manufacture warranty.

LCD MONITOR

General Description

The unit shall be a 10” LCD colour monitor used with a programming keypad to program Traficon VIP video detection systems.

Specifications:

- • Display:
- • Brightness:
- • Power:
- • Screen Size:
- • Input:
- • Weight:

VGA/A V/BNC
200CD/M^2
110V (Power Supply Included), 3A 10” (Diagonal) (800 x 600)
BNC (RCA to BNC Cable Included) 3.3 lbs.

Warranty

The supplier shall provide a limited two-year warranty on LCD Monitors. See suppliers standard warranty included in the Terms and Conditions of Sale documentation.

During the warranty period, technical support shall be provided from the supplier via telephone within 4 hours of the time a call is made by a user, and this support shall be available from factory-certified installers.

Measurement and Payment

LCD Monitors shall be measured and paid for at the contract unit price per each. This shall include all associated equipment required for proper installation.

MICROWAVE VEHICLE RADAR DETECTION

Microwave detectors are mounted above the ground and beam a cone shaped area to an approaching vehicle which reflects some of the microwave energy back to the detector thereby providing a momentary contact closure (pulse) to indicate that a vehicle has been detected. This type of detection can be considered in areas where detector pavement installation is not possible, i.e., pavement is in poor condition or right-of-way is limited.

1. The traffic ENGINEER should define the area of detection.
2. The Microwave detector Must be fixed-mounted and located so that there is

   unobstructed line of sight to the area of detection.

3. The Microwave detector should be located so that the cone of detection is aimed at

   the approach that requires detection. The detector should be oriented along an axis which is parallel (or nearly parallel) to the approach being detected. The minimum detection speed is normally 5 to 5-1/2 mph.

4. Since microwave detectors cannot provide for presence, the phase must be on lock.

PEDESTRIAN DETECTOR

Pedestrian Detectors shall be pushbutton operated at low voltage (not more than 15 volts AC or 24 volts DC).

Pedestrian Detectors shall be mounted on supports as specified on the plans. Breakaway connectors shall be installed on conductor cables for pedestrian detectors on pedestal poles. Breakaway connectors shall be fused for the hot conductor and non-fused for the grounded conductor. The location of the breakaway connectors shall be in the hand hole for the pedestal pole.

Refer to PEDESTRIAN PUSH BUTTON section of these specifications for more information.

IN-ROAD TRAFFIC SENSOR

A typical in-pavement vehicle detection assembly shall include wireless sensors embedded in the pavement, access point, the interface card to be installed in a NEMA TS1 or TS2 cabinet, and any associated hardware. The system shall be able to provide presence detection, volume, occupancy, speed and vehicle classification data. The system shall work within a detection range of 150 feet without using a repeater.

ROADSIDE SPEED INDICATOR

A typical roadside speed indicator assembly includes a LED speed indicator having a standard sign with “YOUR SPEED” message, a cabinet with either solar array or 110V batteries, wiring harness and the associated hardware. The unit shall be in compliance with MUTCD specifications. The unit shall be flexible enough to be mounted either on a pole or on a trailer. Wireless scheduling capability would be a plus. The unit shall be provided with a minimum 2-year warranty period against defective workmanship.

Warranty

The CONTRACTOR shall provide materials with a manufacturer’s warranty/guarantee, transferable to The County Department of Environmental Services, that the supplied materials will be free from all defects in materials and workmanship for the stated time period from the date of shipment. The CONTRACTOR shall supply the ENGINEER with any warranty/guarantee documents from the manufacturer and a copy of the invoice showing date of shipment.

Measurement and Payment

Detectors shall be measured and paid for at the contract unit price per each. This shall include all associated equipment required for proper installation.

7.13: EMERGENCY PRE-EMPTION

VEHICLE PRE-EMPTION

General Description

The system shall handle all emergency as well as transit vehicles provided with valid vehicle ID's. A typical pre-emption package includes one (1) on-board emitter (including switch, cable and hardware), one (1) interface unit, two (2) road-side detectors (including two (2) hangers, cable and hardware).

The pre-emption device shall work with the existing on-board equipment on The County Fire Department's fire trucks without modifying existing main switch function. Also, the device shall have a capability to integrate the Automated Vehicle System application in future.

Optical detectors for emergency vehicle pre-emption shall be the 3M Model M711 or M721 Optical Detector or latest model, as needed. Placement of the detectors shall be determined by the ENGINEER.

Timer modules for emergency vehicle pre-emption shall be the 3M Discriminator, Model M562, which handle two channels of detection.

Optical emitter for emergency vehicle pre-emption shall be the latest 3M model. The emitter shall be programmable for priority and identification purposes via internal switches. The on-board emitter shall transmit industry standard carrier frequency for emergency band signals, (14.035 +/- 0.003Hz) or for Transit Band Signals (9.639+/- 0.0014Hz).

The road-side detector shall sense and transform the signal from the on-board emitter that is to be decoded by the interface unit. The detector shall sense emitter signals over an adjustable range of 200 feet to 2500 feet in optimum atmospheric conditions. The detector will be designed for mounting at or near an intersection on mast arms, pedestals, pipes, or span wires.

The interface unit shall be designed to be installed in the TS-2 traffic controller (EPAC 300 and M-50) cabinet to decode the signals from the road-side detector. The interface unit shall be able to recognize a low (transit) / high (EV) signal and shall give low/high output to the signal controller by ensuring that only authorized vehicles with valid vehicle ID's are granted priority or pre-emption. This interface device shall also be able to read, communicate and store pre-emption and priority requests data to a centralized remote database management system, including but not limited to date, time, direction and vehicle ID. A minimum of 2-year warranty period against defective workmanship is required.

The CONTRACTOR shall notify the County, ENGINEER, and the local fire department when optical detectors are operational for testing prior to final acceptance.

Measurement and Payment

The Optical Detectors shall be measured and paid for at the contract unit price each. This shall include labour, mounting, aligning and re-aligning per the ENGINEER, and any other incidentals necessary for installation.

The Discriminator Modules shall be measured and paid for at the contract unit price each. This shall include mounting, internal electrical wiring, and any other incidentals necessary for installation.

The Optical Emitter shall be measured and paid for at the contract unit price each.

7.14: ELECTRICAL CABLE

Contractor shall use conductor 7 cable.

Power service conductors shall be THWN soft drawn copper, installed per the NEC and shall be black and white in colour.

Loop detector wire shall be single conductor No. 14 AWG, stranded THHN. Loop detector wire shall be encased in 1/4" OD PVC or polyethylene tubing.

Detector loop and pedestrian push-button lead-in cable shall be shielded single or multiple twisted pairs in jacketed cable. Conductors shall be No. 16 or 18 AWG stranded copper. The pairs shall be twisted at least six turns per foot. The cable jacket shall consist of black high-density polyethylene. The jacket shall not be degraded by prolonged exposure to typical pavement runoff components. A stranded tinned copper drain wire shall be provided. The cable shall be suitable for operation at temperatures of -70°F to +170°F.

Ground wire shall be single conductor, No. 8 AWG, soft-drawn bare copper wire.

Optical detector lead-in cable for the emergency vehicle pre-emption optical detectors shall be 3M Model M138 or approved equivalent.

Where specified on plans, underground interconnect wire shall be No. 19 AWG minimum, with 6 twisted pairs minimum, shielded cable, with petrolatum polyethylene gel filling compound. The cable shall meet Rural Electrification Administration (REA) Specification PE-39 (Clifford of Vermont Catalog #6P19B1-BJFC). No splicing of the interconnect cable will be allowed. The cable shall be installed between two adjacent controller cabinets in continuous runs. All cable pairs will be connected to either active or spare terminal points provided in the controller cabinet. The CONTRACTOR shall identify and label all terminal points. At the terminal points the jackets shall be stripped and the ends taped. Gel filling compound shall be removed using filled cable cleaner. A warning ribbon shall be installed above the interconnect wire.

Where specified on the plans, overhead interconnect wire shall be a 1/4" strand galvanized steel messenger cable integrated into the jacket to form a Figure 8 cross- section and shall meet REA Specification PE-38.

All twisted pair and overhead interconnect wires shall be checked after installation to determine their resistance and resistance to ground. Each pair shall be shorted together at one end and a resistance check will be made at the other end. Resistance will also be checked between each conductor and ground. All resistance readings shall be recorded showing value, colour and location or wire. Data is to be supplied to the County Department of Environmental Services within 30 days of completion of the project.

Luminaire wire shall be UF12-2 plus ground and UL listed.

Electrical cables maybe disconnected from existing Traffic Control Device(s) and rerouted through new or existing conduit systems, handholes, span wires, mast arms and/or structures for reconnecting the traffic control device(s) as specified in the contract documents, or as directed by the ENGINEER.

Measurement and Payment

All electrical cable(s) shall be measured and paid for at the contract unit price per linear foot (lf), for each respective cable.

Disconnect, Pullback & Reroute Cables will be measured and paid for at the contract price per Linear Foot and shall for one or as many cables as are disconnected from a specified device and rerouted back to the device (not per cable). The payment will be full compensation for all materials, labor, equipment, tools, and incidentals necessary to complete the work.

7.15: ELECTRICAL SERVICE General

Electrical service shall be installed in accordance with the requirements of the NEC and the local power company. The CONTRACTOR shall procure the meter bases and transformer cabinets from the local power company. CONTRACTOR. The County will request and pay for electrical service and temporary electrical service for items temporarily relocated or adjusted for the purpose of traffic control shown on the plans or directed by the ENGINEER. If the CONTRACTOR desires temporary service for his convenience, he shall arrange and pay for the service.

Refer to Section 5.02 for Grounding and Bonding.

Construction

Work shall conform to details TS7-11, TS7-12, TS7-13.1 and TS7-13.2 and the requirements specified under Section 238 of the VDOT's *Standard Specifications for Road and Bridge Construction (latest edition)*.

Measurement and Payment

Electrical service will be measured in units of each and will be paid for at the contract unit price per each. This price shall include service poles, safety switches or breaker boxes, service entrance conductor cables from the utility company's service box, conductors to the safety switch and circuit breaker box, conduits and fittings on poles and steel supports, conduit straps or clamps, meter base, service entrance heads, thimbleye bolts, steel supports, wireway, junction boxes for grounding electrode and utility service, excavation, concrete, and pickup and installation of meter base and current transformer cabinet.

7.16: BATTERY BACK-UP (UPS) General Description

A typical UPS assembly includes the UPS unit, battery package, auxiliary cabinet and the switching device. The UPS system shall have the following requirements:

1. Furnish and install a Field Hardened Battery Backup System to be mounted to the side of a traffic controller cabinet.
2. Furnish, assemble, fabricate, or install new corrosion resistant materials in accordance with specifications. Supply a "rack mounted" UPS unit, including a front panel with indicators and control switches, as shown on the plans.
3. This specification is for establishing the minimum requirements for a complete emergency battery backup system for use with Light Emitting Diode Traffic Signal Modules at intersections with NEMA, 170 or 2070 cabinets. The Battery Backup System (BBS) shall include at a minimum, the following:
    - • Inverter/Charger
    - • Batteries
    - • A separate automatic and manually operated Bypass Switch and all necessary

      hardware and interconnect wiring.

    - • The BBS shall be capable of providing power for full run-time operation for an

      "LED –only" intersection (all colours: red, yellow, green and pedestrian heads) or

      flashing mode operation and intersection Red LED's.

    - • The BBS shall be designed for outdoor applications.

      Enclosure Construction

      1. Enclosure

         1. The BBS Enclosure shall be capable of being a Side Mount and Ground

            Mount.

         2. The enclosure will house the batteries, UPS and bypass switches. The cabinet must meet the requirements for NEMA 3R enclosures. The housing must have the dimensions so that it may easily be attached the side of a M, P or 332 Type cabinet. Dimensions of the enclosure shall not exceed 50"H x 17" W x 17" D. The UPS enclosure must not interfere with the opening of the traffic cabinet door. The complete enclosure and door must be made from .125" thick aluminium. All external seams must be continuously welded.
         3. Door
            a. The cabinet must have a door to provide access to the complete cabinet interior. The door must have a three (3) point locking mechanism with rollers at the ends for the latch rods. The key lock must be a Corbin cylinder lock with a #2 key. When the door is opened it must have stops at 90, and 130 degrees. A continuous neoprene

gasket must be used to weatherproof the enclosure when the door is closed.

4. Ventilation Fan
   a. A fan must be mounted in the air baffle at the top of the cabinet with an air outlet built into the overhang. The fan must be thermostatically controlled. The bottom of the door must be louvered to allow airflow. A removable dust filter must be located behind the vent.
5. Finish
   a. The entire enclosure must be powder coated black aluminium.
6. Features
   a. When the UPS is mounted into the enclosure it must be mounted to accommodate straight-on horizontal viewing of the LCD screen on the UPS. 6. Generator Connection
7. a. The enclosure shall include a flush mount generator compartment with neoprene gaskets for weatherproofing. The generator compartment shall include a Locking 30 amp plug, L5-30P, for connecting of a portable AC generator. A manual transfer switch shall be mounted within the generator compartment to allow for transferring from utility power to generator power. The generator door will provide a cable slot to allow for closing of the door when the generator is plugged in and to lock the cable inside of the compartment. The door will include a Corbin Type 2 lock.
8. 7. Mounting
   a. The cabinet will be mounted to the traffic control cabinet with six 6 hex head bolts, 1⁄4" x 20". All holes will be field drilled by the Contractor to accommodate the specific situation. A grommet must be supplied to protect the cable in a field drilled 1.5" to 2" hole for cable connection to the existing traffic controller. The Contractor will supply all the mounting hardware, bolts, washers, nuts, gaskets, bushings, grommets, caulking, etc., necessary to install the cabinet in a safe and weatherproof manner.

Battery System

1. Individual batteries shall be:

1. a) Voltage rating: 12V type ConFlow Battery Device in full test capacity with primary support device as per battery pack spec from SPE.
2. b) Amp-hour rating: 100 amp-hour minimum

c) Group size: 31 minimum

d) Batteries shall be easily replaced by approved CPG engineer.

2. Batteries used for BBS shall consist of 4 to 8 batteries. All batteries must meet the specifications out of the box immediately after the initial 24-hour top off charge.

   Batteries used for back up that require cycling to meet the AH rating specifications are not acceptable.

3. Batteries shall be deep discharge, sealed prismatic lead-calcium based GEL/VRLA

   Gelled Electrolyte/ Valve Regulated Lead Acid). ConFlow Batteries are designed for Cycle applications, such as Solar. Back up battery must be designed for Standby Applications.

4. Batteries shall be certified by the manufacturer to operate over a temperature range of – 25 °C to +74 °C.
5. Batteries shall have a Manufactures Warranty of 4 Years Full Replacement plus 1 additional year when a battery balancer is used. The warranty shall cover any battery that does not meet 80% of its original reserve capability during the warranty period.
6. The batteries shall be provided with appropriate interconnect wiring and corrosion-resistant mounting trays, shelf's and/or brackets appropriate for the cabinet into which they will be installed.
7. Batteries shall indicate maximum recharge data and recharging cycles.
8. Battery Harness
    1. a) Battery interconnect wiring shall be via two-part modular harness.
    2. b) Part I shall be equipped with red (+) and black (-) 30.48 cm (12") cabling that can be permanently connected to the positive and negative posts of each battery. Each red and black pair shall be terminated into an Anderson style Power Pole connector or equivalent.
    3. c) Part II shall be equipped with the mating Power Pole style connector for the

       batteries and a single, insulated Power Pole style connection to the inverter/charger unit. Harness shall be fully insulated and constructed to allow batteries to be quickly and easily connected in any order to ensure proper polarity and circuit configuration.

    4. d) Power Pole connectors may be either one-piece or two-piece. If a two-piece connector is used, a locking pin shall be used to prevent the connectors from separating.
    5. e) All battery interconnect harness wiring shall be UL Style 1015 CSA TEW or Welding Style Cable or equivalent, all of proper gauge with respect to design current and with sufficient strand count for flexibility and ease of handling.
    6. f) Battery terminals shall be covered and insulated with moulded boots so as to prevent accidental shorting specifically for the ConFlow device.

9. Battery charging voltage on all batteries in the string to within ±60mV between any two batteries. The Balancer shall allow for any single 12V battery within the battery string to be replaced at any time throughout the warranty period and not require the purchase of new batteries, to install the battery covered under the warranty.

Balancer: The battery balancer shall be provided that automatically balances and all installations hosting the ConFlow device to be fitted with Batteryware units for 24/7 monitoring purposes and safety.

BBS Operation

1. They shall provide a minimum 3 days of full run-time operation with an additional 2 to 4 hours of Red Flash operation for an “LED-only” intersection, with a maximum 800W active output load capacity. The inverter, when on batteries, shall operate with a minimum efficiency of 84% with a load ranging from 25% to 90% of the BBS total output rating. The BBS shall operate at 97% or higher when operating under normal condition (utility power is available).
2. The BBS, for safety and efficiency shall operate with a nominal 48 VDC buss. A DC level higher then 56 VDC shall be considered unsafe and not acceptable.
3. The maximum transfer time allowed, from disruption of normal utility line voltage to stabilized inverter line voltage from batteries, shall be 5 milliseconds. 5 milliseconds maximum allowable transfer time shall also apply when switching from inverter line voltage to utility line voltage.
4. The BBS shall include a rack mounted Fail-Safe Automatic/Manual Bypass Switch for bypassing the UPS for maintenance. The FS-ATS bypass switch will be a 3-stage configuration, UPS Normal mode, bypass UPS on and bypass UPS off. The FS-ATS Bypass Switch shall mount in a 19” rack inside of the BBS side mount enclosure.
5. The BBS shall provide the user with 6-sets of normally open (NO) and normally closed (NC) single-pole double-throw (SPDT) individually programmable dry relay contact closures, available on a front panel-mounted terminal block, rated at a minimum 120V/1A, and labelled so as to identify each contact.
6. One set of NO and NC contact closures shall be energized whenever the unit switches to battery power. Contact shall be labelled or marked “On Batt.”
7. A second and third set of NO and NC contact closures shall be energized whenever the battery approaches approximately 40% of remaining useful capacity. Contact shall be labelled or marked “Low Batt.” This setting must be adjustable from 10% to 90% via the RS232 connection.
8. A fourth set of NO and NC contact closures shall be energized two hours after the unit switches to battery power. Contact shall be labelled or marked “Timer.” This setting must be adjustable from 1 Min. to 8 Hours via the RS232 connection.
9. A fifth set of NO and NC contact closures shall be energized in the event that an Alarm condition occurs. Contact shall be labelled “Alarm”.
10. A 48 VDC output shall be provided for operating an external fan. This output can also be factory configured as a dry contact
11. Relay contact activation shall be annunciate on the front panel via a visual indication. This can be either discreet LED, or part of LCD screen, etc.
12. The BBS shall have (2) independently programmable timers 0 to 8 hours with (2) times-of-day restrictions on each timer, providing dry contacts to provide Red Flash operation at user definable times of day.
13. The BBS shall provide 3 user inputs to support Intrusion Alarm, Emergency Power Off (EPO) and external Self-Test (Battery Test).

14. Operating temperature for both the inverter/charger, and manual bypass switch shall be –37 °C to +74 °C with a load of 850 watts.
15. The Fail Safe ATS Bypass Switch shall be rated at 240VAC/30 amps, minimum
16. The BBS shall use a temperature-compensated battery charging system. The ConFlow charging system shall compensate over a range of 2.5 – 6.0 mV/ °C per cell. The

temperature sensor shall be external to the inverter/charger unit. The temperature sensor shall come with 3 meters (9'10") of wire. .

17. Batteries shall not be recharged when battery temperature exceeds 50 °C ± 3 °C.
18. BBS shall bypass the utility line power whenever the utility line voltage is outside of the following voltage range: 85VAC to 175VAC (± 2VAC). During a utility input from 85 VAC to 175 VAC the UPS shall utilize it's internal double buck, double boost regulation to maintain a 108 to 131 VAC output to the controller cabinet, without the use of the batteries. The BBS shall go into Boost Mode 1 when the AC Line voltage reaches below 110 VAC, +/- 2volts. When the AC line drops below 96 VAC, +/- 2 volts the BBS shall go into Boost Mode 2. When the AC line voltage reaches 131 volts, +/- 2volts the BBS shall go into Buck Mode 1. When the AC Line voltage reaches 150 volts the BBS shall go into Boost Mode 2.
19. When utilizing battery power, the BBS output voltage shall be between 110 VAC and 128 VAC, pure sine wave output, ≤ 3% THD, 60Hz ± 3Hz.
20. BBS shall be compatible with NEMA, 170 or 2170 Controllers, and cabinet components for full time operation. All loads to the maximum rating of the BBS shall be powered through the BBS system to utilize the UPS internal Buck/Boost regulation.
21. In cases of low (below 85VAC) or absent utility line power, when the utility line power has been restored to normal for more than 3 seconds, the BBS shall transfer from the Boost Regulation Mode or the battery backed inverter mode back to utility line mode.
22. In cases of high utility line power (above 175VAC), when the utility line power has been restored to normal for more than 3 seconds, the BBS shall transfer from the Buck Regulation Mode or battery backed inverter mode back to utility line mode
23. BBS shall be equipped to prevent a malfunction feedback to the cabinet or from feeding back to the utility service. For conformation the UPS module must be UL/CSA approved and labelled. "Tested to" or "Built to" UL/CSA is not acceptable.
24. In the event of inverter/charger failure, battery failure or complete battery discharge, the Fail Safe Transfer Switch shall revert to the NC (and de-energized) state, where utility line power or generator power, if available, is connected to the cabinet.
25. Recharge time for the battery, from "protective low-cut-off" to 90% or more of full battery charge capacity, shall not exceed eight (8) hours, unless limited by the Temperature Regulated charger due to excessive battery heat that could damage the integrity of the battery string.
26. All ConFlow Batteries shall be Deep Discharge or Input Kill Voltage enabled, Gel Type Valve Regulated Lead Acid Battery.

Maintenance, Displays, Controls and Diagnostics

1. The BBS shall include a display and /or meter to indicate current battery charge status and conditions.
2. The BBS shall provide voltmeter standard probe input-jacks (+) and (-) to read the exact battery voltage drop at the inverter input.
3. The BBS shall have lightning surge protection compliant with IEEE/ANSI C.62.41.
4. The BBS shall be equipped with an integral system to prevent battery and or ConFlow Device from destructive discharge and overcharge.
5. The BBS and batteries shall be easily replaced with all needed hardware and shall not require any special tools for installation.

6. The BBS shall display via an LCD panel to indicate the number of times the BBS was activated and the total number of hours the unit has operated on battery power. The LCD display shall show the UPS mode, Alarm status, Input and output voltages, Output current, Battery voltage, battery charger current and last event. It shall allow for programming of the battery charger from 3, 6 and 10-amp charger setting.
7. The BBS shall include two separate communication ports on the front panel of the UPS, a factory installed internal Ethernet port for SNMP/WEB communications along with an RS 232 port for local communications.
8. The BBS shall include a Microsoft Windows® Graphical User Interface for programming and monitoring the BBS. This must be provided in addition to the use of Hyper Terminal and provided at no cost.
9. Manufacturer shall include a set of operation manuals and wiring diagrams of the BBS with each BBS. Two sets of Maintenance Manuals, Equipment List and the battery data sheets shall be provided upon request for evaluation purposes.

Acceptance

1. Production Quality Control tests shall be performed on each new system prior to shipment. Failure to meet these requirements shall be cause for rejection. Each system shall be visually inspected for any exterior physical damage or assembly anomalies. Any defects shall be cause for rejection.

Materials Warranty

1. Manufacturers shall provide a two (2) year factory-repair warranty for parts and labor on the BBS from date of acceptance but not more then 6 months from ship date.
2. Batteries shall be warranted for full replacement for four (4) years from date of purchase with an additional 1-year added when a battery balancer is installed at time of initial installation. A battery shall be considered bad should it not deliver 80% of its original capability within the stated warranty period.
3. The warranty shall be included in the total bid price of the BBS.

Measurement and Payment

Battery Back-Up (UPS) systems shall be measured and paid for at the contract unit price each, which shall include the complete UPS unit, battery package, auxiliary cabinet, switching device, all batteries and harnesses, installation, electrical work, grounding, and all other incidentals. The payment shall be full compensation for all materials, labour, equipment and all other incidentals necessary to complete this work.

7.17: CLOSED CIRCUIT TELEVISION (CCTV) CAMERAS General Description

This section details furnishing, installing, integrating, and testing of closed circuit television (CCTV) cameras at locations shown in the Plans and as specified by these Special Provisions.

Materials

1. Functional Requirements

   All CCTV cameras shall have a minimum of 450 lines per frame, interlaced 2:1, per EIA-170A standard. No interlace jitter or line pairing on the viewing monitor shall be discernible. The frame frequency shall be 30 frames per second. The width to height aspect ratio shall be 4:3. The system shall be capable of providing clear, low-bloom and low-lag video pictures under all conditions from bright sunlight to night-time scene illumination. Colour quality shall be maintained by a continuous "through the lens" automatic white balance system.

   Equipment supplied shall be identical at each field installation location and shall be completely interchangeable.

2. Electrical Requirements

   All colour video cameras shall be Digital Signal Processing (DSP) units of solid-state design, and shall meet or exceed the following requirements:

   - Imager: Interline transfer Charge Coupled Device (CCD).
   - Image Area: 3.6mm (H) x 2.7mm (V) [1⁄4" Format]
   - Resolution: NTSC - 450 horizontal; 350 verticals
   - Picture Elements: 768 (H) x 494 (V)
   - 22X optical zoom, 8X digital zoom
   - Effective Zoom Range 176:1
   - Horizontal Angle of View: Optical: greater than 47° at wide zoom, less than 4° at telephoto zoom.
   - Auto Focus mode with manual override.
   - Pan/Zoom/Focus Pre-sets: Sixty-four (64) pre-set positions
   - Auto or Manual shutter speeds of 1/60 – 1/10,000 second.
   - Auto Iris with manual over ride.
   - Automatic Gain Control (AGC): 0 to 14 dB
   - Automatic White Balance with manual override.
   - Signal to Noise Ratio greater than 46dB.
   - Video Output: NTSC, 0.7 V p-p @ 75ohms, unbalanced.
   - Sensitivity: greater than .125 lux @ 1/4 second shutter speed.
   - Programmable I.D. Generator & Alarm Messages
   - Camera Identification: Up to 20 characters long.
   - Zone identification: Up to 20 characters long.
   - Message Positioning: Can be placed at top or bottom. Left, right positioning accomplished by padding message with spaces.
   - Communication and Camera Addressing Protocol: RS-422 Serial Communication.

3. Environmental Requirements

   All CCTV field equipment shall perform to the stated specifications over an ambient temperature range of -20 degrees F to 130 degrees F and humidity range of 0 percent to 95 percent.

   All camera enclosures shall be designed to withstand the effects of sand, dust, and hose-directed water. All connections shall be watertight.

   Unless otherwise shown on the plans, all CCTV field equipment installed shall be operational in indicated weather conditions and shall be able to withstand a wind load (gust) of 90 mph without permanent damage to mechanical and electrical equipment.

4. Camera Housing

   The camera housing shall withstand ambient outdoor temperatures from –30 degrees F to +140 degrees F and maintain internal temperatures and humidity levels compliant with the camera equipment specifications. The internal humidity of the housing shall be less than 10 percent when sealed and pressurized through a Schraeder valve to 5psi using dry nitrogen gas. Desiccant packs shall be securely placed inside the housing to absorb any residual moisture and decrease internal humidity. A pressure relief valve shall be provided that will prevent the internal pressure from exceeding 7psi.

   The viewing window shall be constructed in such a way that unrestricted camera views can be obtained at all camera and lens positions.

   The camera/lens/housing shall be assembled, and factory tested only by the camera manufacturer at the camera manufacturer facility. The camera shall have been adjusted for colour balance and lens tracking/focus, and all configurable items shall have been properly set per manufacturer’s specifications. Each camera/lens/housing delivered to the project site shall be accompanied with a written certification of assembly and configuration from the camera manufacturer. This certification shall serve as manufacturer’s documentation that the assembly and configuration of the camera/lens/housing equipment was performed in accordance with the manufacturer’s specifications. A sample certification document shall be furnished as part of the materials submittal data.

   The CONTRACTOR shall supply and install a dome type environmental enclosure designed to protect the camera, pan/tilt mechanism, and zoom lens from the harsh outdoor environment. The assembly must be supplied with an integral sun shield to reduce glare. The enclosure shall be fully weatherproof.

   The camera and zoom lens shall be mounted to ensure that the enclosure will not obstruct the field of view of the camera. Sufficient clearance between the zoom lens extended to its furthest point of travel and the dome enclosure wall shall be provided to ensure that mirroring on the window will not be obtained.

The top portion of the dome enclosure shall be manufactured of steel and have a white reflective acrylic coating. Enclosure dome shall be clear optically graded acrylic.

A gas-tight connector shall be required for all wiring entries into the housing. Wiring to the connector shall be sealed with silicon or functionally equivalent compound.

5. Pan-Tilt Unit

   Drive motors shall be capable of instantaneous reversing and shall have overload protections. The pan/tilt motor units shall have the following (pre-set) potentiometers. Braking shall be provided in both pan and tilt movements to enable fast stop and reversal and to prevent drifting.

   The Dome enclosure shall include an integrated Pan/Tilt mechanism to control the camera angle of the camera. The unit shall provide vertical movement from 0 degrees to -90 degrees and horizontal movement of 360 degrees. Tilt speed shall be in the range of approximately 3 to 4 degrees per second and the pan speed shall be approximately 8 to 9 degrees per second. The unit shall be capable of simultaneous pan-and-tilt movements.

6. Camera Control Receiver

   The control receiver shall provide the ability to generate a camera identification message over the video display for text labelling of all 64 pre-set locations. Each identification line shall be programmable up to 20 characters. Two separate lines of text shall be provided for identification of the location, zone and camera I.D. number. The camera I.D. shall be programmable locally. The software, cables and any associated hardware to accomplish this task shall be supplied with the camera control receiver. Camera controls (e.g. pan/tilt/zoom, pre-sets, pre-set character generation titles, AGC, iris control, etc.) shall be provided through the software protocol. On-screen programming shall not be acceptable.

The camera control receiver shall meet the following specific function requirements for the control and drive circuits:

- • Electronic zoom in/out and step
- • Electronic shutter selection
- • AGC and manual gain selection
- • Remote white balance control
- • Pan left
- • Pan right
- • Tilt up
- • Tilt down
- • Manual and auto iris control
- • Iris open/Iris close
- • Sixty-four (64) Pan/tilt position pre-sets stored in non-volatile memory
- • Camera power (latching)
- • Zoom and focus position pre-set
- • One (1) auxiliary output (10-amp relay contact closure).

Each unit shall have a unique address, which is changeable by switch settings. The unit shall respond to the central command only if it is addressed.

The camera shall incorporate an integrated camera control receiver into the Dome Enclosure to control the camera, camera DSP functions and, pan/tilt and lens functions. The protocol and message structure for camera control shall be common for all cameras. No proprietary protocol and message structure shall be used.

The camera control receiver shall receive the command data from the local communications interface as EIA-422 control data. The camera control receiver shall provide the output signals to operate the camera accordingly. The control receiver shall retain up to 64 pre-set positions of all camera, pan/tilt, and pre-set text information when power is removed.

7. Power

All camera, pan/tilt, control receiver, and heater components shall operate from 115VAC 50/60 Hz. (±10 percent) as an input source of power.

All power supplies required to operate the integrated CCTV dome camera shall be included with the camera unit.

8. Communications Interface

A minimum 9600-baud data rate shall be used. Data shall be sent asynchronously as 8 bit with no parity. Each block of data shall include a camera identifier and be accompanied by a checksum calculated on the entire block. When the field unit must transmit data to the control unit at the TOC, it shall raise the Request To Send (RTS) line and keep it raised until all data has been sent. The field unit shall not transmit data unless the Clear To Send (CTS) line from the communications equipment interface has been acknowledged. Complete hardware interface and protocol description shall be supplied as part of the required documentation.

9. Cables and Connectors

Connectors shall be provided and installed that are compatible with the communications equipment interface. Connectors shall be used for connections at the control unit and at the camera, zoom lens and pan/tilt mechanisms. Pressure tight multi-conductor ms-type cable connectors shall be used for camera, zoom lens, and pan/tilt connections.

The camera lead-in cables shall meet the manufacturer's specifications for NTSC video transmission, RS-422 communications, and power. Cables/adapters shall be supplied for connecting the NTSC, RS-422, and power from the camera/controller to the controller cabinet. CCTV lead in cables shall be routed as shown on the plans. Strain relief shall be provided for cables to keep cables from being damaged from over-strain or bending due to the vertical rise up the camera poles. Video and data lead-in cables shall be terminated at the respective ports of the video encoder and video decoder. Power cable shall be integrated into the signal controller cabinet grounding system. Furnish a CCTV lead-in cable that contains conductors for CCTV unit control, CCTV unit power, and CCTV unit video. Measure run between installed location of CCTV unit and the signal controller cabinet where the CCTV unit will receive power and connect to the communications cable. Furnish cable that is

constructed to conduct control signals, video signal, and power over the measured distance (plus 20%) with signal and voltage drops that allow the unit to operate in accord with these Technical Specifications. Furnish CCTV lead-in cable that contains shielding to prevent interference and crosstalk between the data, video, and power conductors.

The NTSC shall feed into video input #1 on the encoder, and the pan-tilt-zoom EIA- 422 interface shall terminate at an EIA-422 to EIA-232 opto-isolated converter. This converter shall connect to the camera control data port of the encoder.

Procedures

Mount the CCTV camera units at a height sufficient to adequately see traffic in all direction or as approved by the ENGINEER. The minimum height shall be 20 feet above ground level and the maximum height shall be 45 feet above ground level. Insure that the CCTV camera is mounted at a height greater than the traffic signal heads at the intersection.

Mount the CCTV camera on side of pole nearest intended field of view and avoids occluding the view with the pole.

Electrically bond each camera and pan/tilt/zoom mechanism and its housing to the CCTV camera attachment assembly using a number 6 AWG braided copper conductor.

Integrate the CCTV camera unit with video encoder unit, equipment cabinet, and equipment cabinet power supply.

Ground all equipment as called for.

Install surge protectors on all ungrounded conductors entering the CCTV enclosure. House the protectors in a small, ventilated weatherproof cabinet attached near the CCTV attachment point in a manner approved by the ENGINEER. The air terminal ground wire shall not pass through this cabinet. Install coaxial cable as required to interconnect fiber optic video transceivers with the CCTV units. Insure that all connections are tight and fully secure.

Documentation

Two Operations and Maintenance (O&M) Manuals shall be supplied for each individual component. A reproducible form of each manual shall also be provided. The manuals supplied for the off-the-shelf items shall be those supplied by the equipment manufacturer. The CONTRACTOR shall also provide the ENGINEER with an IBM PC compatible diskette or CD-ROM containing the manuals developed by the CONTRACTOR. The manuals shall contain as a minimum the following operational and maintenance information:

- • Installation and set-up procedures
- • Functional descriptions
- • Step-by-step system operating instructions
- • Theory of system operation
- • Recovery procedures to be followed in case of malfunction
- • Procedures for updating all data base elements
- • Electrical wiring diagrams

- • Pictorial of components layout on chassis or circuit boards with parts identification
- • Complete performance specifications (both electrical and mechanical) on each unit
- • Instructions for gaining maintenance assistance from manufacturer

Construction

Work shall conform to details TS7-14 and the requirements specified under Section 238 of the VDOT's *Standard Specifications for Road and Bridge Construction (latest edition)*.

Measurement and Payment

CCTV camera assemblies shall be measured in units of each and will be paid for at the contract unit price per each. The price shall include furnishing and installing camera unit, camera lenses, control circuits, accessories, camera housing, pan and tilt units, camera control receivers, cable harnesses, connectors, equipment for accommodating pre-sets, source ID generator, all mounting brackets, mounting hardware (e.g., screws, nuts, bolts, etc.), power cords, transformers, delivery of all required software, installation and configuration of the CCTV unit, factory certification, and testing.

Payment will be made as follows: 25% upon delivery of equipment; 50% upon installation and integration; and 25% upon final project acceptance.

CCTV Lead-In Cable shall be measured in linear feet and will be paid for at the contract unit price per linear foot. The price shall include all terminations at the CCTV camera assemblies and the traffic signal cabinets.

7.18: BEACONS

PEDESTRIAN ACTIVATED RAPID FLASH BEACON

General Description

A typical solar-powered pedestrian activated rapid flash assembly includes dual-indicated (front and back) rectangular shaped two LED beacons with solar array and batteries, pedestrian crossing signs, push-button, additional LEDs for sign/pad lighting and push-button confirmation, and associated hardware. The primary function of the unit shall be to activate stutter flash pattern in yellow signals (through wireless communication at additional units) when a user pushes a pedestrian pushbutton. This unit must have a 2-year warranty period against defective workmanship.

PEDESTRIAN ACTIVATED CROSSWALK FLASHERS

General Description

A typical solar-powered pedestrian activated flasher assembly includes yellow signal heads with solar array and batteries, 12-volt LED signals, and associated hardware. The primary function of the unit shall be to activate flashing yellow signals (through wireless communication at additional units) when a user pushes a pedestrian pushbutton. The unit shall be able to communicate with up to 10 field units simultaneously. The flashing pattern

shall be in compliance with MUTCD requirements. This unit must have a 2-year warranty period against defective workmanship.

PEDESTRIAN HAWK SIGNAL

General Description

A pedestrian hybrid beacon is a special type of hybrid beacon used to warn and control traffic at an unsignalized location to assist pedestrians in crossing a street or highway at a marked crosswalk.

A pedestrian hybrid beacon may be considered for installation to facilitate pedestrian crossings at a location that does not meet traffic signal warrants, or at a location that meets traffic signal warrants, but a decision is made to not install a traffic control signal.

Pedestrian HAWK signals shall be installed per Chapter 4F of the MUTCD (latest edition).

Materials

A pedestrian HAWK Signal shall consist of three signal sections; a circular yellow signal indication centred below two horizontally aligned circular red signal indications. As specified on the plans, HAWK signals may consist of the following components:

- • At least two pedestrian HAWK beacon faces shall be installed for each approach of the major street.
- • A stop line shall be installed for each approach to the crosswalks.
- • A pedestrian signal head and pushbutton shall be installed at each end of the marked

  crosswalk.

- • The pedestrian HAWK signal shall be pedestrian actuated.
- • A “Crosswalk Stop on Red” (R10-23) sign shall be mounted adjacent to the

  pedestrian HAWK signal face for each major street approach.

- • TS-1 type cabinet shall be installed as per TS7-15.

  Construction

  Work shall conform to detail TS7-15 and the requirements specified under Chapter 4F of the Manual of Uniformed Traffic Control Devices (MUTCD), latest edition.

SCHOOL FLASHER ASSEMBLY

General Description

A typical solar-powered school flasher assembly includes a 15 ft pedestal pole (with base, anchor bolts and collar), signal heads with hardware, a cabinet with solar array and batteries, 12 volt DC LED signals, wiring harness, pager programmable time-switch and the associated hardware.

A typical AC-powered school flasher assembly includes a 12 ft pedestal pole (with base, anchor bolts, collar and pole cap), signal heads with hardware and 120 AC volt LEDs, a cabinet with pager programmable time-switch and the associated hardware.

Either system must have the capability to download programming for school schedule/calendar over an alphanumeric paging network, from a central computer or through a palm pilot and be compatible with the County's remote-controlled school flasher database system. The time-switch must be provided with a minimum of 2-year warranty period against defective workmanship.

Series Time Switch Specifications

Display

Keyboard Back-up Power Electrical Connection

Output
Line Voltage Time Base

Size

Temperature Range

16 Character, Alpha-Numeric, Liquid Crystal Display(LCD), Back-lit Display Optional
16 Key, Positive Action Push Button
48 Hour Capacitive

Terminal Block (#12 to #20 AWG) or CPC Connector with Harness (optional)
SPDT Relay Rated at 15 Amps 115 VAC Resistive Load
95 to 135VAC, 60Hz and 12VDC

AC Powered (power line) Back-up and DC Powered +/-.005% Crystal
7.6"h x 3.7"w x 1.55"d (AP21)
8.0"h x 3.7"w x 1.55"d (AP21T)

2.0" x 2.5" x 4.0" (AP21TR) -30 to +74°C

Measurement and Payment

Flasher assemblies shall be measured and paid for at the contract unit price per each. The unit price shall include the cost of furnishing all labor, materials, tools and equipment necessary to complete the work as specified including but not limited to solar panels, batteries, battery cabinets with pad locks and switch keys, flashing beacon signal heads and all wiring and interconnects as required and necessary to complete the work. All miscellaneous hardware required for the installation of the flasher assembly as well as testing of the unit shall be included under this item. The cost of the panels, posts, post excavation and concrete foundation will be paid for under their respective items.

7.19: TRAFFIC SIGNS General Description

Work shall consist of furnishing, fabricating, refurbishing, and erecting signs as specified on the plans.

Materials

Reflective sheeting shall conform to the requirements under Section 247 of VDOT's

Standard Specifications for Road and Bridge Construction (latest edition).

Construction

All work shall conform to the procedures under Section 701 of VDOT's *Standard Specifications for Road and Bridge Construction (latest edition)*.

Measurement and Payment

Sign Panels shall be measured and paid for at the contract unit price per square foot. This shall include background sheeting, sign messages, framing units, mounting, labour, and all other incidentals required for installation.

Overlay Sign Panels shall be measured and paid for at the contract unit price per square foot. This shall include verification of size and colour of overlay panel, removal of existing overlay and demountable messages including borders, fabricating, furnishing, installation, and all other incidentals required for installation.

7.20: GROUND MOUNTED SIGN SUPPORTS

SQUARE PERFORATED TUBULAR STEEL POSTS

General Description

Furnish and install Square Perforated Tubular Steel Posts and Square Perforated Tubular Steel Anchor Bases for mounting traffic signs as specified in the contract documents, or as directed by the ENGINEER.

Materials

Steel Posts
Galvanizing
Spray Galvanizing Compound

A570 Grade 50
A653 Designation G-90 A780

Square Tubular Steel Posts and Square Tubular Steel Anchor bases must be formed from 12 gauge steel. All sides of the tubes shall have 7/16 in. die punched circular holes or perforated knock-outs, at one in. centres along their entire length.

The Tubular Steel Posts shall be two in. square tubes 12 ft long.

Square Tubular Steel Anchor Bases shall be comprised of two telescoping tubes. The first shall be 2 1/4 in. square, three ft long, formed from 12-gauge steel and shall snugly fit over the sign post. The second section shall be a 2 1/2 in. square, 18 in. long, formed from 12-gauge steel, and shall snugly fit over the 2 1/4 in. section.

Construction

The Square Tubular Steel Anchor Base assembly shall be constructed by placing the 18 in. base section over the 3 ft base section so that they are flush at the top and the holes are aligned. The entire unit shall be driven into the ground so that one or two rows of holes in the Square Perforated Tubular Steel Base are exposed. The base shall be driven so that it remains plumb and to provide the final sign assembly with the correct orientation.

Finished length of the Tubular Steel Posts shall be determined by adding the total height of the signs to 8 Ft, 2 in. The sign post shall be cut to the correct length, and cold spray galvanizing shall be applied to the cut end. The signs shall be bolted to the top of the post, using tamper proof bolts or drive rivets. The Square Tubular Steel Posts shall be lowered 8 in. into the base, and the post secured to the base using two corner bolts designed for this purpose.

Measurement and Payment

Square Tubular Steel Posts will be measured and paid for at the contract unit price per each. The payment will be full compensation for the sign post, corner bolts, and painting as required, and for all materials, labour, equipment, tools, and incidentals necessary to complete the work.

Square Tubular Steel Anchor bases will be measured and paid for at the contract unit price per each. The payment will be full compensation for both tubes comprising the base section, all excavation, and for all materials, labour, equipment, tools, and incidentals necessary to complete the work.

WOOD SIGN SUPPORTS

General Description

Work shall consist of furnishing and installing wood sign supports as specified on the plans.

Materials

Wood Supports shall be No. 1 dense Grade.

Construction

Auger or dig holes using methods approved by the ENGINEER. Place supports in a plumb position and to specified depth and lateral orientation. Backfill using suitable excavation material, and compact in place. Do not drive or hammer supports into undisturbed earth.

When specified, wood sign supports shall have drilled holes conforming to the breakaway requirements specified in AASHTO Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, or as shown in the Contract Documents.

When wood sign supports are installed in concrete areas, pvc conduit sleeves shall be installed as directed by the ENGINEER.

Measurement and Payment

Wood Sign Supports shall be measured and paid for at the Contract unit price per linear foot for the length and size specified. This shall include excavation, backfill, drilled holes, conduit sleeves, material, labor, tools, equipment, and all other incidentals required for installation.

7.21: TRAFFIC SIGNAL TURN-ON, PICKUP, REMOVAL AND MAINTENANCE
General Description

This work shall consist of pickup of The County furnished materials, removal of existing equipment, and maintenance of existing equipment as specified in the Contract Documents or as directed by the ENGINEER.

Construction

Equipment Turn-On:

- • Notify the ENGINEER and The County representatives within 10 working days prior to completion of the project to allow the County to install any additional traffic control device.
- • Notify the ENGINEER and The County representative five working days prior to the completion of the project to schedule a final inspection and turn-on.
- • Stakeout, with the ENGINEER present, the proposed construction as indicated on

  the plan.

  of County Furnished Materials:

Pickup

- • Notify the appropriate members of The County a minimum of 72 hours in advance of anticipated pickup of materials furnished by the County.
- • The CONTRACTOR shall be responsible for the transportation, labour, equipment, tools and incidentals necessary to obtain and load any County furnished materials.
- • Materials not furnished by the County shall be furnished by the CONTRACTOR.

Removal and Disposal of Existing Material and Equipment:

- o • Remove concrete foundations 12 inches below grade. All holes caused by this removal shall be backfilled, compacted and restored to surrounding conditions.
- o • Remove all existing hard rubber detectors and handholes not shown on the Plans

  to remain. The holes shall be backfilled, compacted and restored to surrounding conditions. The sidewalk where handholes are removed shall be reconstructed to the nearest tooled joint or expansion joint. The roadway where hard rubber detectors are removed shall be reconstructed in conformance with The County utility patch repair standards.

- o • Disconnect existing inductive loop detectors and magnetic detectors not shown on the plans.
- o • Disposal of all material not salvaged. Non-galvanized green painted structures may contain lead and the CONTRACTOR will be responsible for proper disposal of such material.

Storage of Materials:

• Materials shall be bundled, stored, and protected in conformance with the manufacturer's recommendations or as approved by the ENGINEER.

Maintenance of Materials and Equipment:

- • The County will continue maintenance of any existing signals until the CONTRACTOR places new equipment into operation.
- • When the work requires adjustments to the traffic control devices to maintain the minimum County standards, the adjustments to the traffic control devices shall be made within 4 hours of verbal notification by the ENGINEER. Failure to comply with this time period will result in the county performing adjustment and deducting the cost of the adjustment from the CONTRACTOR'S payment.
- • Existing signals shall remain in their original condition until the new signals have been completed, satisfactorily tested and its operation accepted by the ENGINEER.
- • Maintain the continuous operation of all vehicular and pedestrian detectors. If any detector is damaged by the CONTRACTOR, it shall be repaired within 72 hours after notification by the ENGINEER.
- • All traffic signals and existing interconnect cable shall be operational and actuated as specified in the Contract Documents.
- • Plan the work to minimize interference with any existing traffic control device.

Measurement and Payment

The payment will be full compensation for all material, labour, equipment, tools, and incidentals necessary to complete the work for one or more of the items specified in the Contract Documents.

Equipment Turn On will not be measured but the cost will be incidental to other pertinent items specified in the Contract Documents.

Pick-up of County furnished materials will not be measured but the cost will be incidental to other pertinent items specified in the Contract Documents.

Removal and disposal of existing signal material and equipment will be measured and paid for at the Contract unit lump sum price.

Materials storage, cable sealing and handling, adjustments to maintain minimum Administration standards on existing signals made necessary by new signal or geometric modifications and CONTRACTOR repair of any damaged detector caused as a result of CONTRACTOR'S error will not be measured but the cost will be incidental to other pertinent items specified in the Contract Documents.

97

SIGNAL ACTIVATION POLICY & PROCEDURE

Traffic Signal Activation Procedures – Activation of a new traffic signal is a critical part of the signal installation process. The traffic signal designer should consider the possible consequences of a change in traffic control and add any notes and items which may improve the safety of the transition period.

The following steps are recommended for the activation of a new traffic signal:

1. **Advance Flash Period – A new traffic signal installation should be put on flash operation for a period of seven days (or as directed by the Engineer) to allow motorists to gain familiarity with the intersection operation. Make sure flashing operation does not conflict with existing signs.**
2. **Publicity – The date and time of the activation of signal operation should be shared with project engineer and County's communication staff prior to and on the date of activation.**
3. **Activation – The actual activation of normal signal operation should be made during an off-peak traffic period.**
4. **Technical Support – The contractor and County Signal technicians shall be on-hand for all new traffic signal activations to immediately trouble shoot or fix any problems that arise.**
5. **Signing Adjustments – Once the traffic signal is turned on, remove the stop signs that the traffic signal replaces.**
6. **Police Assistance –Construction manager would decide if there is a need for police assistance on site at the time of traffic signal activation to provide emergency traffic control in case of a malfunction and to help emphasize the new traffic control change to the motorists. If needed, the Construction manager shall contact police.**

7. **Fine Tuning – Shortly after the traffic signal is turned on, the engineer should observe the signal's operation during both peak and off peak periods to assure the adequacy of the signal's timing parameters.**
8. **Pavement marking and roadway signs– Ensure all pavement markings including stop bars are installed prior to the day of turning on a signal. Temporary pavement markings are acceptable when pavement work is being done (A prior approval from the Engineer is necessary). The construction manager shall coordinate the pavement marking work with the project manager / developer / county's pavement marking engineer / pavement contractor at the time of issuing PO.**

   Ensure availability of approved pavement marking plan before start of construction.

Requirement of approved traffic control signs and street name signs must be identified before issuing of PO.

Manufacturing of control signs and street name signs must be initiated at the time of initiated PO for construction.

9. Preconstruction meeting – It is mandatory to have preconstruction meeting for all signal projects in the County. A signal activation policy shall be handed out in that meeting.

10. Signal Construction by Developer – All the items described in this policy shall be followed by all signal construction contractors.

11. Existing Signal Modification by Contractor – The contractor shall inform the County signal staff before turning on from old signal to new signal. The County signal staff should be present at the time of switchover from old signal to new signal.

12. Exception – If the contractor needed any waiver due to different ground situation, a written request shall be submitted to the County with justification. The County will consider Contractor's request based on the facts presented.

13. Final Walk-Thru – Upon Completion of the project, a final walk-thru shall be conducted with construction manager, design engineer and project manager.

14. Complete checklist – Prepare the checklist as attached.

Intersection Activation Checklist

Installation and /Or Modification Final Inspection Report

Location.	ID. #

Scope/Description of Work:

Actual Start Date

Inspection Date

Final Re-inspection Date

Primary Contractor

Flash Date

Primary POC

Turn On Date

Signal Contractor

Signal POC

AC Project Inspector

Dominion Power Meter #

Traffic Signal Inspection Checklist

Date	Item Inspected	P	F	Comments
	Stake Out –Pole, Junction Box and Cabinet Locations			
	Pole Foundations – Depth, Diameter, Conduit and Rebar			
	Veh / Ped Signal Mounting-Mast Arm/Span Wire Height, Location, Alignment, Fixtures Securely Mounted			
	Grounding - Cabinet, Meter Pedestal, Poles and Junction Boxes			
	Grounding Reading			
	Junction Boxes – Position of Conduit, Cable Loop, JB Clean, Grouted, Gravel Bed at Bottom of JB			
	Poles – Pole Caps, End Caps Hand Hole Covers, Nut Covers			
	Cabinet and UPS – Secure on Base, Wiring, Wires Marked or Labeled, Police Cabinet switch			
	Pre Emption Equip- Location and Wiring.			
	Loops – Position, Saw Cut, Sealed, Cable twisted in hand box and tested for continuity.			
	Push Buttons - Height, Signs and Alignment, detection zones			
	Video Detection / CCTV – Height, Position, Alignment			
	Signal Operation Test- Controller Timings, UPS, Video/ Loop Detection., Pre-Emption, Push Buttons, All Veh/Pedestrian Signal Displays, Interconnect			
	Signage and Markings - Completed Per Signal Plan			

Punch list only good for 30 days. After 30 days, this site is subject to total re-inspection.

Punch List Item	Completion Date/Note

Sign Off

Contractor POC / Date
AC Inspector / Date

SECTION 8: SIGNAL DESIGN REQUIREMENTS 8.01: DESIGN ELEMENTS

All signals shall be designed to meet the following minimum requirements unless directed by The County:

- • Signal poles located in all • quadrants of the intersection
- • Fully-Actuated •
- • LED signal heads
- • LED pedestrian signals with •

  Polara style APS pushbuttons in •

  all quadrants •

- • ADA compliant curb ramps in •

Emergency Vehicle Pre-emption (EVP) devices for all approaches
Colour Video detection for all approaches

One (1) CCTV per intersection Interconnect signal communication Battery back-up
All cabinets shall be Size-P, Type TS2

all quadrants of the intersection

8.02: PLAN DEVELOPMENT

• Street name signs mounted close to mast arm pole

Traffic signal plans shall be prepared on 1" = 25' scale CADD base sheet, and at a minimum include all design elements as well as the following information unless directed by The County:

- • Existing and proposed signal equipment
- • NEMA signal phasing
- • Detectors
- • Conduits
- • Junction boxes
- • Signal poles
- • Signal heads
- • Controller cabinet
- • Pedestrian facilities
- • Signing
- • Pavement markings

• Lighting
• Construction notes
• Wiring diagram
• Location of existing and proposed

power source (if necessary)
• Location of underground and overhead

utilities
• Geometric improvements
• Existing ROW
• Proposed ROW
• Traffic signal timing information • Fiber Optic Splice diagram

Required Plan Sheets and Contents for Stand-Alone Traffic Signal Plans

All The County signal plans should require the following plan sheets and the described contents at a minimum.

For signal plans in which existing communications are to be maintained, the communications plan may be omitted.

For signal plans submitted as part of a larger plan set, the format of the required contents may be modified.

NOTE: Items indicated by ** should be included in 30% submittal. All other items should be provided in subsequent submittals.

1.

2.

Coversheet**

a. Include at a minimum: The County general traffic signal construction notes, a location map, table of contents.

Traffic Signal Plan (Traffic Signal Modification Plan)**

3.

4.

5.

a.

Include at a minimum:

- • Existing pavement markings (either to remain or to be eradicated) **
- • Proposed pavement markings including stop bars, crosswalks, lane arrows,

  etc.**

- • Dimensions for lane widths and marking spacing
- • Parking and bicycle markings as needed**
- • Required width, type, and colour for proposed markings

a. Include at a minimum:
• proposed and existing

• pole schedule with part numbers per The County Specification TS7-

signal equipment**
• proposed and existing 1.1

signs**

- • phasing diagram**
- • conduit schedule
- • legend**
- • proposed markings

(screened)**

Pavement Marking Plan**

• pedestrian push-button detail
• construction notes, timing chart
• enlarged insets where needed to show

detail**
• pole location detail** • bolt circle diagram
• boring locations

Signal Communications Plan

a. Include at a minimum:

- • Existing communications layout
- • Proposed communications layout
- • Fiber Optic splice diagram (provided by County if needed)

Summary of Quantities

a. Include at a minimum:

- • Existing items to be removed
- • Existing items to be salvaged
- • Proposed items to be installed

PART II: STREETLIGHT SPECIFICATIONS

SECTION 9: STREETLIGHT INSTALLATION INSTRUCTIONS FOR DEVELOPERS 9.01: GENERAL

The Department of Environmental Services Construction Standards and Specifications shall be followed when installing roadway lighting foundations, poles, and luminaires in non-residential areas.

The purpose of this document is to provide an understanding of street lighting installation requirements for developers. Except as otherwise specifically required by the approved PLANS or this document, all work shall fully comply with the Department of Environmental Services, Construction Standards and Specifications. In case of any discrepancy or inconsistency between or among requirements, this document shall govern over the Construction Standards and Specifications.

9.02: INSTALLATION OPTIONS

Street lighting program is administered through the Department of Environmental Services, Division of Transportation (hereinafter referred to as the COUNTY). The developer has two options for installing the streetlights: 1) The developer can install the street lighting system or 2) Pay The County to install the street lighting system. The usual delivery time for the poles and lights of either option is about 90 days. Therefore, streetlight planning shall occur early in the development process. The County will maintain street lighting installed by the DEVELOPER within the Right of Way.

If the DEVELOPER elects The County to install the street lighting system, the DEVELOPER shall contact the Division of Transportation, Street Light Engineer, to request an estimate and before any work is to begin. The DEVELOPER must then issue payment to the COUNTY before work can begin.

9.03: PROCEDURES

If the DEVELOPER elects to install the street lighting system, the following procedures and the approved materials for street lighting installation shall be carried out. Strict adherence is required to ensure project acceptance and/or bond release. The COUNTY must inspect and approve all street lighting improvements. Developer is required to contact the County Streetlight Inspector to schedule a preconstruction meeting.

_____

_____

_____

The DEVELOPER shall design the streetlighting system as per the current The County Traffic Signal and Streetlight Specifications and submit for approval prior to beginning of construction. All work shall be performed in compliance with the NEC Regulations unless otherwise specified

SECTION 10: CONSTRUCTION GUIDELINES FOR DEVELOPERS AND CONTRACTORS

10.01: INSPECTIONS

The DEVELOPER shall contact the COUNTY at least 72 hours in advance to schedule inspections and final acceptance. The COUNTY must inspect all underground conduits before back filling, pole foundations, and electrical work. Final project acceptance shall occur upon final inspection, when DEVELOPER demonstrates that all lights are operational; and the DEVELOPER provides as-built plans for the lighting system. As built plans must indicate the location of the meter pedestal and control circuit. In addition, the plan notes should indicate the following:

1. The number of circuits used.
2. The size of circuit breaker used for each circuit.
3. The size and type of wire used.
4. A statement as to which circuit controls each light.

EXAMPLE: Circuit #1 – 20amp - (3) # 6 wire marked with red tape – Feeding lights 1,3,5,7.

10.02: AS-BUILT DRAWINGS

As-built drawings should be submitted in AutoCAD and Adobe (.pdf) format to the County Streetlight Inspector. A sample as-built drawing can be found on drawing number LT-18 of this publication.

SECTION 11: STREETLIGHT MATERIALS 11.01: EQUIPMENT

All equipment used shall be as per the The County Traffic Signal & Streetlight Specifications. This document provides the methods to assemble or install the equipment for a final product. Contractors are responsible for contacting the County should the specifications be unclear or incomplete.

11.02: BOLTS

All anchor bolts installed for roadway lighting shall be galvanized.

11.03: FUSES

All fuse holders shall be breakaway receptacles for Impact Disconnect, 10 amps by Ferraz Shawmut with model number FEB-11-11 or approved equal.

11.04: JUNCTION BOXES

All junction boxes for residential areas shall be 12”X12” Quazite PC1212HA00 (lid) and PC1212BA12 (box). For commercial applications, all junction boxes shall be 13”X24” Quazite PT1324HA00 (lid) and PT1324BA18 (box). All the covers shall have “STREETLIGHT” stamped on.

Street lighting conduit shall be 24 inches deep and shall be no more than 36 inches behind the curb. The purpose of this requirement is to avoid conflicts with street tree planting. Any other location for conduits shall not be accepted, unless specifically approved by the COUNTY.

11.05: UNDERGROUND CONDUCTOR

Underground conductor shall be pulled from pole to pole in the underground duct. Unless otherwise specified by the COUNTY, underground conductor shall be #6 Copper 3-conductor underground electric cable, (unless otherwise directed by County's representative) and shall be UL approved. Refer to the NEC Regulations for load calculations. There will be four conductors with two hot (A & B), one neutral, and one ground. The cable shall be coloured as follows:

Black for circuit A Red for circuit B White for neutral Green for ground

The wiring for the poles shall be installed alternatively in two different circuits. For example, sixteen (16) poles shall be installed as follows:
Pole Numbers 1, 3, 5, 7, 9, 11, 13 and 15 shall be installed on one circuit, and
Pole Numbers 2, 4, 6, 8, 10, 12, 14 and 16 shall be installed on the second and alternate circuit.

The in-pole wire shall be no smaller than a #12 copper stranded wire and shall be spliced into the light wire block at the upper end, and the service conductors in the base of the pole. An approved breakaway fuse shall be wired in the hot leg of each light pole. The

wiring device used to make the connection MUST be approved for both aluminium and copper wires.

A continuous grounding conductor shall be installed for grounding purposes.

All conduits, anchor bolts, and reinforcing bar cages shall be made mechanically secure and bonded to the pole to form the grounding electrode system. An 8'x 5/8" copper ground rod shall be installed to supplement the grounding electrode system. The ground rod shall be installed inside the pole foundation when no junction box is available. A non-conducting sleeve shall be installed in the foundation to ensure the ground rod does not contact the concrete. A ground rod shall also be installed in the junction box adjacent to the service equipment.

11.06: ELECTRICAL COMPONENTS (METERED SERVICES)

The DEVELOPER shall arrange for the electrical service and install all components of the service. Metered services shall be directly coordinated with Southern Power Edison. At the Pre-Construction meeting, the COUNTY must approve the recommended location of the meter and disconnect switch as shown in the Site Plans. The ground for the electric service shall be isolated from the building ground. The service shall be three- wire 120/240 and a minimum of 100 Amps for overhead service and a minimum of 200 Amps for underground service.

11.07: METERED UNDERGROUND SERVICES

For metered underground services, the meter pan and disconnects shall be mounted in an outside meter pedestal, in public Right of Way, close to the streetlight's meter. The DEVELOPER is responsible for installing the meter pedestal.

11.08: CENTRAL STREETLIGHT CONTROLS

A shorting cap shall be installed in the photo control socket. Photo control shall be achieved through a central control circuit at the disconnect box.

A central streetlight control shall be installed next to the disconnect box for the streetlights. Normal streetlight operation shall be achieved through the photo control and contactor switch. The manual switch shall over-ride the photo control and will be used as a technician switch. Service equipment shall be installed according to NEC regulation. A sample configuration in the pictures below is shown for information purposes only.

The following parts shall be used for the central streetlight control which is to be mounted on the side of the meter pedestal:

Photocell: Tork model 2101 photo electric switch 109

Rain tight 2000W(T) 1800VA 120VAC. 50/60 Hz

Enclosure: Hoffman Enclosure Enclosure Type 3R

Cat. Number A12R126HCR Contactor: Siemens 42BF15AF

HOA Switch: General Electric CR104PSG34B91A

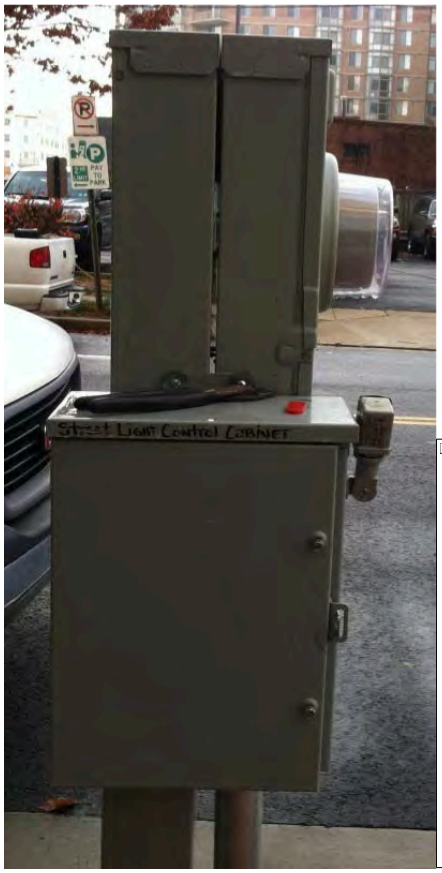
Figure 1: Sample configuration of central streetlight control.

11.09: CIRCUIT BREAKER

The circuit breakers used should be based on the calculated load of the street light circuit.

11.10: DISCONNECT SWITCH

The disconnect switch shall be a Siemens W0816ML1125CU with 125 Amp. 110



The picture can't be displayed.

11.11: METER PAN

Meter pan shall be a Southern Power Edison standard 200 AMP meter base, single phase service and type 3R enclosure, Catalogue No.-100628

11.12: METER PEDESTAL

Meter pedestals shall be Company Model Numbers are R281C1P6H or R208CP6HP. Both with 200 AMP main.

11.13: COBRA LED

Cobra LED will be Philip Lumec Roadstar catalog number GPLM-180W98LED4K-ES-LE3-120-BL-[CDMG-016]-PH8-USA-WB7 with color option specified either Textured Black (BKTX) or Textured Grey (GY3TX).

11.14: CONTACT INFORMATION

Division of Transportation
Transportation Engineering and Operations ……..

SECTION 12: STREETLIGHT DESIGN GUIDELINES 12.01: GENERAL

The State is transitioning to upgrade its street lights system to an energy efficient LED streetlights system. To promote safe roadway conditions for both motorized and non-motorized traffic the projects that will impact the existing street lighting conditions will require proper engineering design and light level calculations as detailed in this policy guideline document.

All projects involving streetlights will have a full-engineering design and cost estimation before a project goes to construction level. Pole location, conductor size and service location shall be determined by the design engineer based on engineering calculations and shown on the separate street lighting plan sheet.

Depending upon the roadway and site conditions the luminance level (lighting levels) on a roadway / street will be determined according to *IES Roadway Lighting Guidelines* and *AASHTO Roadway Lighting Design Guide* using the Illuminance Method. The County and or The State will provide the minimum illuminance level required for various roadway situations.

The County approved fixtures, poles and LED Lights including iLamp units and multiple technology components to be specified in each individual project. The County will provide specification for the fixtures, poles and LED Lights.

12.02: DESIGN REQUIREMENTS

To accomplish proper engineering design, following items are required to complete the design plans:

- • The existing roadway lighting system should be shown in detail including but not limited to: existing pole locations, pole numbers, ownership, power feed, and light type.
- • A field review should be conducted to verify existing streetlight fixtures and other site condition that may impact the new lighting design.
- • Early coordination work with Southern Power Edison.
- • The lighting analysis calculation including mounting height, IES type, cut off

  classification, photometric data, luminaries location, and surrounding existing street

  lighting information

- • Luminaires call-out with the fixture, wattage, circuit number, lighting type, mounting

  height and location (station/offset).

- • Call-out with cable/conduit quantities and size. Voltage drop calculation, a voltage drop of 5% at the furthest receptacle in a branch wiring circuit is acceptable for normal efficiency.

- • Photometric and photometric calculation files (AGI-32). Use Power Factor (PF) of 0.98, and Light Loss Factor (LLF) of 0.95 for County approved LED streetlights.

12.03: MINIMUM ACCEPTANCE CRITERIA

The following requirements refer to the site plan minimum acceptance criteria and guidelines.

1. Project Limits with road names
2. Right-of-Way lines
3. Existing streetlights
4. Removal of streetlights (Dominion lights and non-standard County lights)
5. Voltage drop calculation

a. Voltage drop calculation for entire modified/proposed street lighting system including feeder (from service point to service meter) and branch (from service meter to the furthest street light)

6. Location of meter and power source
7. Photometric calculations

a. Each block should have separate calculations 8. Photometric calculations for intersections

a. This should be separate from the roadway photometric calculations

9. Photometric calculations for the sidewalks
10. Conduct and cable runs and sizes
11. Foundation details
12. Junction boxes / splice boxes
13. Poles, fixtures and light details

Street light planning shall occur early in development process. **The review period would require a time frame of at least two weeks.** Developer and Consultant shall fulfil all requirements for county review process unless the County decides to waive one or more requirements, provided the level of lighting is satisfied based on the IES roadway lighting guideline and AASHTO roadway lighting design guide. Developer shall provide a complete set of plans and support files for final acceptance and inspection work.