

TSP 301
SPECIAL PROVISIONS FOR TRAFFIC SIGNALS & ITS
IN MARYVILLE & ALCOA, TN

PART 1 GENERAL

1. Certification of Personnel
 - a. For installation of any traffic control device or equipment, or intelligent transportation systems (ITS) related equipment, an IMSA Level II (or higher) certified technician shall supervise and be present on site while work is being performed.
 - b. Proof of IMSA certification shall be required in the form of a certification card accompanied by photo ID.
2. Traffic signals and ITS includes but is not limited to: the furnishing and installation of poles, cabinets, foundations, conduit, fiber optic cable, conductor cables, electrical power service, and other required vendor software/hardware necessary to complete a fully functioning system.
3. All the equipment provided shall comply with the applicable industry approved standards for the subsystems and communications network. Use of approved industry standards and the National Transportation Communications for ITS Protocols (NTCIP) shall be required for the traffic signal and closed-circuit television (CCTV) devices.
4. All equipment and component parts that are furnished shall be new, with warranty and not used or refurbished, shall meet all requirements of this special provision, and shall be in an operable condition at the time of delivery. All parts shall be of high-quality workmanship and no part or attachment shall be applied contrary to the manufacturer's recommendations or standard practices. All materials and installation of all devices shall be in accordance with this special provision, plans, and with the manufacturer's recommendations for the exact intended application.
5. All electrical materials and work shall conform to the standards of the National Electrical Manufacturers Association (NEMA), the Underwriters' Laboratories Inc. (UL), the Electrical Testing Laboratories (ETL), the National Electrical Testing Association (NETA), Institute of Electrical and Electronics Engineers (IEEE) and the Electronic Industries Association (EIA), wherever applicable. In addition to the requirements of the approved shop drawings to be prepared by the Contractor, and these Special Provisions, all materials and workmanship shall conform to the requirements of the National

Electrical Code (NEC), National Electrical Safety Code (NESC) and applicable codes of governing jurisdictions. Unless specified, all standards used shall be the latest edition available.

6. Submittals

- a. Within 45 Days of Notice to Proceed, the Contractor shall submit to the Engineer for approval a submittal package containing equipment catalog cut sheets and technical specifications for all items listed in this special provision and any related items. The catalog cut sheets and technical specifications shall include all necessary information to clearly demonstrate that the proposed equipment meets the requirements of this special provision and the Plans. In addition, the equipment cut sheets shall include manufacturer's name, model number, and any other descriptive data as necessary to clearly evaluate the item. Interface Protocols for all devices and equipment should also be submitted.
- b. Materials shall not be ordered or released for fabrication without the approval of submittals by the Engineer.
- c. The review and approval of submittals by the Engineer is based on the information provided in the submittal and the conformance with the design concept of the project. Submittal reviews do not relieve the contractor of the responsibility for making the overall system conform to the requirements of the contract. Approvals at the submittal stage are always conditional upon demonstration that the equipment is fully compliant with the Contract including compatibility with all other equipment in the system.
- d. Within 90 days of Notice to Proceed the Contractor shall submit to the Engineer shop drawings and design calculations for all structural elements and attachments including, but not limited to: all sign structures, support poles, structure attachments and foundations.
- e. The Engineer will review and return submittals to the Contractor within 21 days of receipt. If additional information is requested or if a re-submittal is required, the Contractor is required to re-submit within 21 days of receipt of the Engineer's comments.

PART 2 TRAFFIC SIGNALS

1. Traffic Signal Controller

- a. The standard signal controller for use in the Cities of Maryville & Alcoa is the **MCCAIN ATC-eX2 NEMA** configured for either ATC, TS2-Type 1, TS2-Type 2, and TS1 applications.
- b. The traffic signal controller, **MCCAIN ATC-eX2 NEMA**, shall have the following features:
 - Omni eX Intersection Control Software
 - A-B-C-D Deck Board
 - Two (2) SDLC ports
 - Minimum of two (2) 10/100Base-T Ethernet ports w/ internal configuration
 - Minimum of two (2) high speed USB ports
 - Shelf mount form factor
- c. The traffic signal controller, **MCCAIN ATC-eX2 NEMA**, shall meet the following functional requirements:
 - Meets or exceeds ITE / AASHTO / NEMA ATC standards
 - Linux Operating System with memory management for process isolation
 - Compliant with NTCIP 1201 and 1202
 - 256MB flash memory
 - 256MB DRAM
 - 2MB non-volatile SRAM
 - Backup Real-Time Clock
- d. It shall be the contractor's responsibility to ensure that the most current firmware is installed on the controller.
- e. Traffic signal controllers shall be replaced or repaired by the manufacturer if a controller fails to function as intended due to workmanship or material defects within the first 24 months from the date of being put into field operation at no cost (including shipping) to the Cities of Maryville & Alcoa.
- f. For each new controller furnished by the Contractor, one hard copy of the user's manual shall be provided by the Contractor and placed in the plastic envelope inside the cabinet.

2. Signal Monitor Unit

- a. The standard cabinet monitor unit (CMU) for an **ATC Cabinet** shall be **MCCAIN CMU-2212 series** interfaced with *SmartMonitor* Technology to **EDI Auxiliary Display Unit**

- b. The CMU, **MCCAIN CMU-2212 series**, shall have the following features:
- 32 Physical channels with optional 4 virtual channels
 - Programmable with Interchangeable Datakey
 - Load Current Monitoring
 - Field Check Monitor
 - Event Logging
 - Signal Sequence History Log
 - Front panel Ethernet port
 - Dedicated RESET button
- c. The CMU/MMU for **TS2 Cabinets** shall be **EDI MMU2-16LE(ip)** with the following features:
- NEMA TS-2016 Standard
 - NEMA Standard Flashing Yellow Arrow PPLT
 - Standardized communications
 - Full intersection & Status display
 - Event Logging
 - Setup Wizard
 - Diagnostic Wizard and Help system
 - TS-1 Type 12 with SDLC mode
 - Program Card Memory
 - LEDguard
 - Access monitor data using ECcom PC Software
- d. It shall be the contractor's responsibility to ensure that the most current firmware is installed on the monitor.

3. Traffic Signal Controller Cabinet

- a. The cabinet shall be a **SWARCO (MCCAIN) 350i ATC Cabinet** base-mounted enclosure type. The cabinet shall be a natural, galvanized finish. The cabinet shall be constructed and furnished to the specifications in **“MACTO 350i ATC Cabinet HV Specification”**
- b. The cabinet foundation shall follow the Cities of Maryville's and Alcoa's cabinet foundation detail “MACTO CD 1.0_Cabinet Detail”

4. Battery Back-Up System

- a. This system shall be a **Myers Battery Backup MP2000 or approved equivalent**. This system shall be rack mounted in the 350i ATC cabinet. The cabinet shall be furnished with a single 48VDC battery array consisting of four (4) 12VDC, 105AH batteries, required cable harness, elated equipment, and the

UPS, which includes converter/inverter/charger unit, power transfer relay, power management unit, manually operated power transfer switch and other control panels and wiring harnesses.

- b. The UPS cabinet door shall be hinged on the right side of the cabinet. Cabinet doors shall provide full access to the cabinet interior and shall have durable gaskets to ensure weatherproofing. The door shall be equipped with the Department's standard tumbler lock. Two keys for each cabinet shall be provided to the Engineer. Hinges shall be stainless steel and continuous. Doors shall have a doorstop arrangement that will allow it to be firmly positioned at 90 and 135 degrees, ± 10 degrees. The locking system for cabinets shall be a three-point draw roller system. Rollers shall be fabricated from nylon with a diameter of at least 8/10 inch. The door opening shall be double flanged on all four sides.
- c. Cabinet doors shall have a screened and louvered vent design to prevent rain entry, with a standard size furnace vent filter. The filter tray shall be sized to house and secure the filter in place. The screen shall be constructed from at least 0.031-inch aluminum with 1/8-inch diameter openings positioned on 3/16-inch staggered centers.
- d. The interior of cabinet shall be of sufficient size to provide adequate ventilation of the equipment housed therein. Cabinet shall contain at least three adjustable shelves or equivalent supports, with enough space to hold UPS, batteries, battery trays and brackets, wiring and related equipment. Vertical mounting channels for the shelves shall be continuous and shall allow for adjustable shelf placement ranging from 5 inches from the bottom to 5 inches from the top of the cabinet. Shelves and vertical mounting channels shall be heavy duty and have sufficient strength to hold the batteries without deforming, bending or breaking. Wiring panels and terminal blocks shall be neatly finished and clearly and permanently marked with identifications applied by silk screening. Conductors shall be neatly arranged and bundled in groups with cable ties. The bundled conductors shall not obstruct access to other circuits and terminals in the cabinet.
- e. This system shall consist of a true-on-line, power conditioner and digital signal processor based uninterruptible power system (UPS) designed for transportation and traffic applications. The inverter shall be in operation at all times capable of supplying clean regulated power (both voltage and frequency) to all loads at all times.
- f. This system must be fully power factor corrected and fully functional with any type of auxiliary power generator.

- g. The UPS shall meet or exceed NEMA temperature standards from -40° C to +74° C. The UPS shall be certified, and field proven to meet or exceed NEMA temperature standards. A certificate of compliance shall be supplied with the Traffic UPS. The UPS internal component boards shall be conformal coated.
- h. The UPS system shall be installed in conformance with the Manufacturers recommendations and as specified herein.
- i. Alarm function monitoring through the UPS shall be through a standard DB-9F connector with open collectors (40V @ 20mA) indicating:
 - Loss of utility power
 - Inverter failure
 - Low battery
- j. Full interactive remote computer monitoring, and control of the UPS functions are to be added via an external SNMP/HTTP adaptor with 10/100 auto-sense fast Ethernet port located on the front of the UPS.
- k. The Windows configuration software shall allow the user to monitor and control the following UPS functions through a direct connection to the USB Type B/Ethernet port on the UPS:
 - Real time input/output status including frequency, voltage, current and power.
 - Real time battery status including charge type, on time totals, charge level, voltage, current and temperature.
 - Real time nominal output rating, nominal output power, nominal low battery time, audible alarm status and nominal battery life.
 - Active alarms – input bad, output bad, overload, bypass bad, output off, UPS shutdown and charger failure.
- l. Input Specification shall meet the following minimum requirements:
 - Nominal Input Voltage: 120 VAC, Single Phase
 - Input Voltage Range: 100-130 VAC
 - Input Frequency: 60 Hz (+/- 3)
 - Input Step Load Response: ½ Cycle Full Recovery (Full resistive load)
 - Input Current: 30 Amp (Resistive)
 - Input Protection: 30 Amp circuit breaker
 - Input Battery String Voltage: 48 VDC (Four 12 VDC Battery)
- m. Output Specification shall meet the following minimum requirements:
 - Nominal Output Voltage: 120 VAC, Single Phase
 - Power Rating, VA/W: 2000 VA / 1500 W
 - Output Power Factor: 0.75

- Output Voltage Regulation: 100-130 (+/- 2) VAC (follows the input voltage) 120 VAC (+/- 5%)
 - Output Waveform: Sin Wave
 - Output Waveform THD: < 3% (resistive load)
 - Load Crest Factor: 3:1 (max)
 - Overload Capacity: 110% for 3 minutes
- n. The external battery system shall be certified, and field proven to meet or exceed NEMA temperature standards from -40° C to $+74^{\circ}$ C. Batteries shall be the 105+ Ampere-Hour rating type. Batteries shall meet MIL SPEC B-8565J for hydrogen gas emissions. Batteries shall not exceed 2.25 square feet. Batteries shall be AGM design with epoxy sealed casing. Batteries shall have power pole connectors with wiring welded to battery posts. Battery posts with welded wires shall be sealed to prevent corrosion.
- o. External battery system shall consist of a single string of four deep cycle, 105+ Ampere-Hour batteries which connects to the UPS without a hardware change to the UPS. The batteries shall be provided with appropriate interconnect wiring harness. This harness shall connect the battery pack to the UPS module.

5. Fisheye Video Detection System

- a. The video detection system shall be a **MIOVISION** system configured to meet the intersection design and traffic signal cabinet requirements.
- b. This system shall come with software module enabling the capability for, but not limited to, pre-emption, collecting data performance metrics and live video streaming.
- c. The system shall meet all the supplier's requirements and best practices.
- d. Substitutions will be considered on a case-by-case basis.

6. Accessible Pedestrian System (APS)

- a. This APS shall be a **Polara iNavigator APS 3-wire System**.
- b. The button housing shall be yellow and include appropriate, compliant MUTCD's R10-3 sign series.
- c. Alternatives will be considered on a case-by-case basis.

- d. APS devices shall meet all ADA, PROWAG, and MUTC requirements.

7. Signal Displays

- a. All signal head assemblies shall include **louvered, vacuum-formed ABS finished backplates** or approved equivalent dull black backplates with **2” retroreflective border**.
- b. Signal head assemblies shall be die-casted aluminum colored yellow (Federal Standard 595b-12538)
- c. Signal visors shall be yellow, aluminum tunnel visors unless specified otherwise.
- d. All signal displays shall be 12” clear, incandescent-look LED compliant with latest ITE VTCSH LED Circular/Arrow Signal Supplement
- e. Pedestrian signals shall be 16” yellow, cast aluminum alloy, clamshell housing mount with vantage visor.
- f. Pedestrian signal LED modules shall be the 16” X 18” countdown pedestrian signals compliant (for Full Hand/Full Person) with the latest ITE PTCSI LED Signal modules

8. Removal of Signal Equipment

- a. All signal related equipment in need of removal from the site shall be returned to Maryville-Alcoa Central Traffic Operations (MACTO) unless otherwise specified.
- b. Removal of signal equipment includes removal of strain/mast arm poles, span wire, controller cabinets and foundations. Any concrete foundation shall be removed to a depth of 2’ below finished grade.

9. New Traffic Signal Installations

- a. All new signal displays shall be covered with a durable black bag when not operational.
- b. It shall be the contractor’s responsibility to ensure that signal displays remain covered and that covers do not become damaged before final removal.
- c. All new intersections will have a minimum flash operation period of 7 days to a maximum of 14 days.

PART 3 INTELLIGENT TRANSPORTATION SYSTEMS

1. Video Standards and Protocols

- a. Digitization of the video signals for transmission shall utilize the H.264 standard, MPEG4, Part 10 Standard, MPEG2 as defined by the International Telecommunication Union (ITU) and Motion Picture Experts Group (MPEG).
- b. CCTV control protocol for pan, tilt, and zoom in addition to other camera controls shall meet NTCIP requirements.

2. Ethernet and IP Standards and Protocols

- a. The Ethernet communications system and all connected devices shall, as an entire interconnected system, completely implement and be compatible with IEEE 802.3 industry standards for Ethernet and NTCIP standards supporting Ethernet as applicable and required.

3. Fiber Optic Infrastructure

- a. Furnish fiber optic infrastructure materials that meet applicable industry standards including but not limited to:
 - EIA/TIA
 - RUS
 - IEEE
 - ICEA
 - Telecordia
 - ASTM
 - UL
 - NEC
 - NESC

4. Fiber Optic Fusion Splice (FO Splice, Fusion)

- a. Provide fusion splices for splicing of all fibers on the project. Do not provide any other type of fiber splicing.
- b. Perform fusion splicing with a fully automatic portable fusion splicer that provides consistent low loss (max 0.10 dB) splices. Splicer shall provide three-axis fiber core alignment using light injection and loss measurement techniques. The fusing process shall be automatically controlled. The splicer shall provide splice loss measurements on an integral display, as well as a magnified image of the fiber alignment.

5. Fiber Optic Connectors

- a. Provide fiber optic connectors compliant with this special provision for all fiber optic infrastructure including, but not limited to, fiber optic termination cabinets, fiber optic enclosure panels, and fiber optic patch cords.
- b. Provide only factory-installed keyed LC compatible connectors for all fiber optic infrastructure. Provide only factory-installed connectors of a type other than LC when required by the Network Switches. Do not use field-installed connectors. Do not use adapter couplers to change connector types.
- c. Use ceramic ferrule connectors factory-installed with a thermal-set heat-cured epoxy and machine polished mating face. Install connectors as per manufacturer application and recommendations, including proper termination to the outer-tubing (900-micron tubing, 3 mm fan out tubing, etc.) required for the application.
- d. Use connectors rated for an operating temperature of -40°C to $+75^{\circ}\text{C}$.
- e. Provide connectors that have an installed insertion loss of less than 0.50 dB, a typical loss of 0.20 dB, and an optical return loss of less than 45 dB.
- f. Use simplex connectors for all male LC connectors. Provide latching cover for two male connectors being used in a duplex configuration. Female couplers may be duplex but must allow simplex mating connectors.
- g. Label each fiber position on panels and termination cabinets containing duplex couplers with the port/position ID as shown in the Plans.
- h. Provide dust caps for all exposed male connectors and female couplers at all times until permanent connector installation.
- i. LC connectors shall comply with TIA/EIA-4750000-C and TIA/EIA-604-10A.

6. Fiber Optic Enclosure Panel

- a. Provide fiber optic wall-mount enclosure panels designed for outside plant use for terminating fiber optic pigtails and drop cables in equipment cabinets.
- b. Use fiber optic wall-mount enclosure panels that are fully compatible with all components of the fiber optic infrastructure as specified, including, but not limited to, fiber optic trunk cable, fiber optic enclosures, integrated fiber optic termination unit, fiber optic fusion splices, and fiber optic connectors.

- c. Use fiber optic patch panels with 12 fiber connectors (duplex LC).
- d. Use permanent labels on the enclosure panel with contrasting color to identify each connector body by its associated fiber number.
- e. Fiber connectors shall be arranged in rows of 1 duplex connector couplers. All fiber connectors shall be arranged on one of the long (vertical) faces of the enclosure.
- f. Provide an outer non-metallic cable strain-relief boot where the fiber pigtail/drop cable enters the fiber connector enclosure panel and that secures the cable and to the enclosure; the strain-relief boot shall fully encircle the cable for a minimum of 2 inches from the enclosure's outer surface.
- g. Use fiber connector patch panel on the enclosure panel that are no more than 2 inches wide and deep (the maximum dimension of the patch panel plus fiber connector body) and no more than 11 inches long.
- h. Provide a 0.125-inch-thick aluminum mounting plate that secures to the fiber enclosure panel. The mounting plate shall have at least four mounting holes near the plate's corners that permit horizontal or vertical mounting flush to a panel and are spaced appropriately for vertical mounting to an EIA equipment rack rail using two of the mounting holes.

7. Fiber Optic Patch Cords

- a. Provide fiber optic patch cords consisting of a length of fiber optic cable terminated on both ends.
- b. All patch cords shall be factory preconnectorized assemblies adhering to all applicable cable and fiber specifications stated in this special provision.
- c. Provide patch cords of the appropriate length for the necessary connections, maintaining minimum bend radius, and with no residual strain at the connector or anywhere on the patch cord itself beyond self-support. Patch cords shall not have excess length beyond what is necessary for equipment connection and routing.
- d. All patch cords shall be duplex zip-cord fiber cable with simplex LC connectors, except as otherwise allowed in Part 3, Section 4.
 - The two connectors of each end of the patch cord shall be differentiated by different colors or with labels.

- Provide sufficient flexibility at each end to disconnect one connector without disturbing the other, or to allow swapping of the two connectors within the same duplex coupler without disturbing the remainder of the patch cord.
 - Provide strain relief and reinforcement at the point where the duplex cable separates for the individual simplex connectors.
- e. Use yellow outer jackets for single mode fiber.
- f. No splices of any type are allowed within a patch cord assembly.

8. Network Switch (Type A) (L2 Field Ethernet Switch)

- a. Layer 2 (L2) Field Gigabit Ethernet Switches will be placed in locations shown on the Plans. L2 Field Switches fabricated for use in traffic signal controller cabinets shall meet or exceed NEMA TS- 2 requirements for temperature, shock, humidity, and vibration.
- b. Furnish L2 Field Gigabit Ethernet Switches that are din-rail mounted and come equipped with hardware to permit mounting on a din-rail in addition to placement on a cabinet shelf and shall be optically compatible with the Layer 3 Traffic Operations Center (TOC) Switch at the Maryville City Government Center.
- c. Furnish Field Gigabit Ethernet switches with internal Power Supply meeting the following power supply requirements:
 - 85 to 264 Vac (50/60Hz)/ 88 to 300Vdc.
 - Power supply shall have two stage isolation accomplished via two transformers: first steps down from primary AC/DC to 48VDC; the second steps down from 48VDC to the final DC voltage required by the switch.
 - A power cord of not less than 5 feet in length shall be supplied.
- d. Furnish Field Gigabit Ethernet Switches that weigh no more than 3 lbs and are no more than 150 cubic inches in volume.
- e. Furnish hardened, ruggedized Field Gigabit Ethernet switches with the following minimum characteristics and features:
 - Minimum of Eight (8) 10BASE-T/100BASE-TX ports
 - i. RJ45 connectors
 - ii. Cable type: Category 5e/, unshielded twisted pair (CAT 5e/ UTP)
 - iii. Auto-negotiation support (10/100Mbps)
 - iv. Auto MDIX crossover capability
 - v. Full Duplex operation (IEEE 802.3x)
 - vi. SPD (Surge Protective Device) between Line +/-, Line +/-ground, and Line –ground to protect the circuitry

- Minimum of two (2) 1000 BaseX Optical uplink ports that utilize SFP modules.
- Furnish SFP modules rated to service the Field Ethernet to Field Ethernet optical uplinks and Field Ethernet to Gig-E Hub Uplink rated for optical attenuation required to service the link. Use SFP modules that are 20km+ LX or ZX and are matched and compatible with the SFP module it is mated with. Furnish attenuators if required to service link without saturating receiving optics.
- Furnish SFP modules rated for use with the optical cable furnished within the project
- Furnish SFP modules with LC connector or another connector approved by the Engineer
- Furnish fiber optic patch cord with appropriate connectors to connect with switch and adjacent drop cable connectors and/or other switches.

9. CCTV Camera System

- a. CCTV Camera Assembly shall be **CostarHD RISE 4220HD series** or approved equivalent which includes, but not limited to, camera, lens, housing, pan/tilt/zoom unit, pole mounting adapter, power over ethernet injector (PoE), PoE repeater, and camera cabling.
- b. CCTV Camera Assemblies shall be compatible with the digital video management software (DVMS) at the TOC.

10. CCTV Ethernet Repeater

- a. Where Ethernet cable length exceeds 300 +/- feet, furnish and install field hardened, weatherproof Ethernet repeater capable of forwarding both power and data over CAT5e/6 gel-filled outdoor rated cable. The Power over Ethernet repeater shall meet the following minimum specifications:
 - Power consumption less than 2 watts (PoE)
 - Support for IEEE 802.3af and or IEEE 802.3at standards
 - Forward a minimum of 60 watts of PoE
 - Two independently auto-configuring 100BASE-T/1000BASE-T, full duplex Ethernet interfaces with RJ45 connectors
 - Ability to accept crossover or patch cable configuration
 - Capable of forwarding data at a minimum nominal speed of 100Mbps
 - Operating temperature rating of -40° F to 140° F
 - Operating humidity 90% non-condensing
 - Maximum dimensions 9.0 inches by 3.0 inches by 2.0 inches

11. CCTV PoE Injector

- a. Furnish and install a PoE++ injector with the following minimum specifications:
 - Interfaces with RJ45 connectors
 - Data rate: 10/100/1000Mbps
 - Output power: 75W
 - Output voltage: 52-57 VDC
 - Input voltage: 100-240 VAC
 - AC current input: 1.5A @ 100-240 VAC
 - AC Hz: 50-60 Hz
 - Operating temperature rating: -40° F to 65° F
 - Operating humidity: Maximum 90%, non-condensing

12. CCTV Pole and Structures

- a. Fifty-foot (50') CCTV pole and foundation with lowering device, conduit, connections, clamps, anchor bolts, shoe bases, and all other members shall be designed and fabricated in accordance with the Standards and requirements listed below. Design and materials documentation shall be furnished as part of the approval request submittal. Certifications will be furnished upon request by the Engineer.
 - AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals, current edition, including all interims and updates shall be met. Design life shall be 50 years for all poles. The "Fatigue Category", "Gallopings Loads" category and "Truck-Induced Gust Loads" would NOT apply to the poles but would apply to the sign structures.
 - Shall be designed to withstand the specified forces including those produced by a 120-mph wind with a 1.14 gust effect factor.
 - The Contractor shall submit manufacturer's shop drawings, layout drawings and specifications for equipment and appurtenances for the approval of the Engineer ninety (90) days after notice to proceed.
 - Fabricator: The Fabricator shall be certified under Category I, "Conventional Steel Structures" as set forth by the American Institute of Steel Construction Quality Certification Program. Proof of this certification will be required.
 - Welding: All welding shall be in accordance with Sections 1 through 8 of the American Welding Society (AWS) DI. 1 Structural Welding Code.

- Tackers and welders shall be qualified in accordance with the American Welding Society Structural Welding code.
- Tube longitudinal seam welds shall be free of cracks and excessive undercut, performed with automatic processes, and be visually inspected. Inspection records will be furnished to the Engineer.
- Longitudinal welds suspected to contain defects shall be magnetic particle inspected. All circumferential butt-welded pole and arm splices shall be ultrasonically and radio graphically inspected. Inspection records will be furnished to the Engineer.
- Camera Pole System shall consist of a pole, anchor bolts, base plate, ground rod array, and communication and power conduits to nearest pull box, grounding conduit, spare conduit, and foundation.
- Design computations for the camera poles shall be complete and shall include but not be limited to the following:
 - i. Consideration for all parts of the structure.
 - ii. Consideration for all possible loading combinations including wind and ice loads.
 - iii. Design stresses and allowable stresses for all components which comprise the proposed structure.
 - iv. The top of the pole deflection shall not exceed the following:
 - 1.5 inches deflection from center (3-inch deflection diameter) due to 30 mph (non-gust) winds for the 50' poles.
 - v. All complete shop drawings and design computations shall bear the stamp of a registered Professional Engineer.
 - vi. Shop drawings shall be approved prior to fabrication. Approval of the shop drawings does not relieve the Contractor of responsibility for the design, fabrication, and erection of the structure.
 - vii. The Engineer reserves the right to reject a pole design if the calculated deflection exceeds that specified herein.
 - viii. The foundation design shall be based on actual soil conditions from soil borings conducted by the contractor. The cost of the soil borings shall be included in the cost of the pole.
- The calculations shall include a pole, base plate, and anchor bolt analysis. The pole calculations shall be analyzed at the pole base, 5-foot pole intervals, and at each slip joint splice.

- For each pole as shown in the plans, the following information shall be given:
 - i. The pole's diameter, thickness, section modulus, moment of inertia, and cross-sectional area.
 - ii. The centroid, weight, projected area, drag coefficient, velocity pressure, and wind force of each trapezoidal pole segment.
 - iii. The axial force, shear force, primary moment, total moment, axial stress, bending stress, allowable axial stress, allowable bending stress, and combined stress ratio (CSR) at each elevation.
 - iv. The pole's angular and linear deflection at each elevation.

- Pole Mounted Cabinet Access Conduit Nipple
 - i. Each pole will be manufactured with a 2" diameter rigid threaded nipple for conduit connection to a pole mounted cabinet.
 - ii. The height of this nipple above the base of the pole shall be such that a cabinet mounting height of 3 feet above ground height can be achieved as shown in the typical details in the plans.

- Hand Holes
 - i. The hand hole openings are reinforced with 2" wide hot rolled steel bar. The opening shall be rectangular and 5" x 8" nominal.
 - ii. The cover shall be 11-gauge steel and shall be secured to a clip-on lock with a tamper-proof screw.
 - iii. The reinforcing rim shall be provided with a ½" tapped hole and ½" hex head cap screw for grounding.
 - iv. For poles with lowering devices two (2) hand holes shall be approximately 18" apart, center to center, or as recommended by the lowering device manufacturer.
 - v. The hand holes shall be fully compatible with the Camera Lowering Device and Portable Lowering Tool. If desired and compatible with the lowering device, one larger hand hole may be provided in place of two separate hand holes.
 - vi. Hand holes on poles with pole mounted cabinets and transformers shall be placed toward oncoming traffic. For all other poles, hand holes shall face away from traffic.
 - vii. Hand holes shall not be oriented on the same side of the pole as the CCTV camera.

- Pole Top Junction Box: All 80' camera poles shall have a pole top connector box fastened to the pole top for cable strain relief.

- Cable Supports (J-Hooks & Eyelets): Top and bottom J-hooks and eyelets shall be located within the pole directly aligned with each other.

- Base Plate:
 - i. Base plates shall conform to ASTM A572.
 - ii. Plates shall be integrally welded to the tubes with a telescopic welded joint or a full penetration butt weld with backup bar.
 - iii. Plates shall be hot dip galvanized.

- Anchor Bolts:
 - i. Anchor bolts shall conform to the requirements of AASHTO M314-90 (105 ksi min. yield.) The upper 12” of the bolts shall be hot dip galvanized per ASTM A153.
 - ii. Each anchor bolt shall be supplied with two (2) hex nuts and two (2) hardened washers.
 - iii. The strength of the nuts shall equal or exceed the proof load of the bolts.
 - iv. The top nut shall be torqued to produce 60% yield stress of anchor bolt.
 - v. The Contractor shall not grout between bottom of base plate and top of concrete foundation.

13. Camera Lowering Device Requirements for 50’ Poles

- a. All poles shall have a heavy-duty Camera Lowering Device(s) (CLD) with the design capabilities of supporting both IP Base and analog base CCTV cabling. The camera lowering system shall be designed to support and lower a Simultaneous DUAL Analog & IP closed circuit television camera, lens, housing, PTZ mechanism, cabling, connectors and other supporting field components without damage or causing degradation of camera operations. The camera lowering system device(s) and the pole are interdependent; and thus, must be considered a single unit or system. The lowering system shall consist of a pole, suspension contact unit, divided support arm, and a pole adapter for attachment to a pole top tenon, pole top junction box, conduit mount adapter and camera connection box. The CLD shall also meet the following requirements. The Camera Lowering Device shall be safely operable by one technician working alone, to lower the Camera Assembly to ground level for maintenance as necessary and return the Camera Assembly to the pole top mounting and secure it in place, eliminating the need for access by a bucket truck.

- b. The camera lowering device’s contact block shall support 1000Base-T Ethernet communication.

- c. Weatherproof connectors (camera to the lowering device) shall allow for adaptation of the camera and the dome type housing for lowering and hoisting and be provided as an integral part of the design to provide a water-resistant seal when the camera is raised and secured in place for surveillance operation.
- d. Lifting and lowering shall be done with a motorized gear box (winch).
- e. The CLD should be a stand-alone device mounted on a camera pole to be supplied by the Contractor and included in the cost of the associated pole.
- f. An integrated CLD with pole assembly may be procured provided it meets all specifications.
- g. The Camera Lowering Device shall be designed to preclude the lifting cable from contacting the power or video cabling. In the case where there is dual lowering devices the lifting cable shall not come in contact with the other CCTV's lifting cable, power and video cabling. The only cable permitted to move within the pole or lowering device shall be the stainless-steel lowering cable(s). All other cables must remain secure and separate from the lowering cable.
- h. The Camera Lowering Device shall support the Camera Assembly a minimum of 20" from the pole.
- i. The composite cable between the camera and the CCTV cabinet will be a continuous run with available slack. No pole top interconnections or splices will be permitted.
- j. The tenon top shall be a plate mounted tenon that allows for field modification of the arm/camera orientation up to 360 degrees. The tenon shall have mounting holes and slots as required for the mounting of the CLD. Unless otherwise noted, when DUAL mount lowering devices, the mounting slots shall be 180 degrees apart.
- k. For dual lowering devices on the same pole the lowering devices shall be designed and installed to work independently of the other. The CLD shall be installed such that the cables from either CCTV will not come into contact with the other's cabling.

14. Portable Camera Lowering Deice Tool

- a. The Contractor shall furnish and test one Portable Lowering Tool capable of being operated by a hand winch and an electric drill motor, which is fully compatible

with the Camera Lowering Device and the Steel Camera Pole and meets the following requirements:

- The Portable Lowering Tool shall be one recommended by the manufacturer of the Camera Lowering Device.
- The Portable Lowering Tool shall have a minimum load capacity of 200 pounds with a 4 to 1 safety factor.
- The tool shall consist of a lightweight metal frame and winch assembly with cable, a quick release cable connector, an adjustable safety clutch, and a variable speed industrial duty electric drill motor.
- This tool shall be compatible with the hand hole of the pole and the Camera Lowering Device inside the hand hole.
- When attached to the hand hole, the tool will support itself and the load assuring lowering operations and provide a means to prevent freewheeling when loaded.
- The Portable Lowering Tool shall be delivered to the Engineer upon project completion.
- The Portable Lowering Tool shall have a reduction gear to reduce the manual effort required to operate the lifting mechanism.
- The Portable Lowering Tool shall be provided with an adapter for operating the lowering device by a portable drill using a clutch mechanism. The Portable Lowering Tool shall be equipped with a positive locking mechanism to secure the cable reel during raising and lowering operations.

15. Suspension Unit

- a. The Contractor shall design the required pole mounting adapters, brackets, and mounting hardware.
- b. The Camera Lowering Device shall have a minimum load capacity of 200 pounds with a 4 to 1 safety factor.
- c. The enclosure receptacle and camera enclosure shall incorporate a mating device.
- d. The mating device shall have a minimum of 2 latching devices. These latching devices shall securely hold the camera housing and its control equipment free of vibration or motion between the enclosure receptacle and camera enclosure.
- e. The latching devices shall lock and unlock by alternately raising and lowering the camera enclosure.
- f. When the camera enclosure is latched, all weight shall be removed from the lowering cable.

- g. The enclosure receptacle and camera enclosure shall have a heavy-duty tracking guide.
- h. The tracking guide and latching devices shall lock the camera enclosure in the same position each time.
- i. Electrical contacts shall be provided to support all camera functions including both IP and analog based CCTVs. The electrical contacts shall be brass, or copper and gold coated to prevent corrosion. The contacts shall be minimum 0.09” diameter, or as approved by the Engineer.
- j. Replaceable gaskets shall be provided to seal the electrical contacts and latching devices from moisture and dust.
- k. The only cable permitted to move within the pole or lowering device during lowering or raising shall be the stainless-steel lowering cable. All other cables shall remain stable and secure during lowering and raising and shall be secured such that it will not come in contact with the steel lowering cable.
- l. The Camera Lowering Device shall be designed to permit a ± 3 degree of horizontal adjustment for leveling the dome enclosure.
- m. The lowering cable shall be a minimum 5/32” diameter stainless steel aircraft cable with a minimum breaking strength of 1740 pounds.
- n. Weights and/or counterweights shall be provided to assure the alignment pin and connectors for the camera connection can be raised into position without binding and that it can be lowered properly.

16. Poles

Standards and posts for the camera poles shall be installed as indicated on the Plans and shall conform to the following requirements:

- a. All poles shall be installed in accordance with the National Electric Safety Code and ASSHTO.
- b. Foundations:
 - The Contractor shall submit a design for pole foundations that has been sealed by a registered Professional Engineer.
 - The foundation design shall adhere to the prescribed loading and wind deflection as specified in TDOT Standards Specification.

- The foundations shall be constructed in accordance with the TDOT Standard Specifications and shall adhere to the approved shop drawings for the loading specified.
 - If soil conditions require the use of any shoring, casings, or sonotube for proper installation of the foundations, the cost of the shoring, casings or sonotube shall be included in the cost of the pole and foundation.
- c. The dimensions and reinforcing steel shall be in accordance with the requirements of Specifications.
- d. Cast-in-place concrete pole foundation shall cure a minimum of 7 days before any load is applied to the foundation.
- e. Conduit shall be installed in the pole foundation for access and includes conduit to the nearest pull box as shown in plans.
- f. A minimum of one 2-inch spare conduit shall be installed in all pole foundations as shown in the Plans Typical Details. Spare conduits in pole foundations shall be sealed with blank duct plugs.
- g. Grounding System
- The Contractor shall supply and install a grounding system with ground rod array at the base of all poles as shown on the Plans.
 - The ground rod array system shall be connected to the pole through an appropriate ground clamp.
 - A #6 AWG copper stranded bonding wire shall be installed between the pole and the field cabinet providing a common ground system for each site.
 - All ground bonding wires shall be unspliced.
- h. The installation method for the CCTV poles and cameras shall be such that the camera can be rotated as needed around the pole for optimum placement.

PART 4 CONDUIT

1. Conduit Detection Wire

- a. Conduit detection wire shall be #12 AWG solid copper orange-insulated THHN conductor
- b. Conduit detection wire is required with all underground conduits installed by any installation method, including trenching, directional boring, or plowing.

- c. Only one conduit detection wire is required per installed conduit segment regardless of the number of conduits installed in that segment.
- d. Conduit detection wire shall be installed inside of an empty conduit when possible.
- e. The conduit detection wire shall be continuous and unspliced between pull boxes and shall enter the pull boxes at the same location as the conduit with which it is installed.
- f. Coil and secure 4 ft. of conduit detection wire in each pull box or vault.
- g. Conduit detection wire is included in the cost of the conduit and will not be measured separately.

2. PVC Schedule 40/80 Conduit

- a. Conduit installation in earth shall be at a minimum depth of 24 inches from the top of the conduit.
- b. Bushings shall be installed in conduit at all exposed conduit terminations for protection of the conductors.
- c. A minimum of one 2-inch spare conduit shall be installed in all pole and cabinet foundations to the nearest pullbox.

3. Rigid Galvanized Steel Conduit

- a. Exposed conduit runs shall be 2" rigid galvanized steel unless otherwise required by the Plans.
- b. All conduit runs on structures and poles shall be properly terminated into the respective device, or a weatherhead shall be installed so as to seal the conduit from moisture, insects, rodents and other foreign material.
- c. Bushings shall be installed in conduit at all exposed conduit terminations for protection of the conductors.