

Knox County traffic signal specifications and plans requirements

Knox County requires that traffic signal equipment and installation complies with Tennessee Department of Transportation (TDOT) Standard Specifications for Road and Bridge Construction, Section 730, applicable TDOT standard roadway drawings (T-SG series), and the requirements of the most recent edition of the Manual on Uniform Traffic Control Devices. We do not utilize City of Knoxville Special Provision 730-K. There are a few exceptions to Section 730 that the County observes as outlined below. All of the following items must be addressed either in the traffic signal plans or on separate sheets.

Pre-design matters

There are several items that must be resolved before a traffic signal design may proceed. The following list is not exhaustive but presents some of the matters to be determined before design begins:

- Will coordination timing plans be required? Who will develop the timing plans?
The designer should provide at least 15 seconds of side-street green time in splits.
- Is a TDOT permit required?
- If the signal is not part of a system, the designer shall include stop bar loops on the main line through lanes.
- If there is an existing signal, who will be responsible for repair of equipment damaged during construction (loops, cabling, etc.)? Also see the specification regarding provision of non-intrusive vehicle detection for projects involving existing signals.
- If an existing signal pole is to be relocated, resolve whether to move the existing pole or to install a new one and salvage the existing one. This will require documentation of the existing pole moment capacity.
- If TDOT is doing the installation, request video or radar detection, PSI battery backup uninterruptible power supply, and other technology enhancements as applicable.
- Will pedestrian upgrades be needed pursuant to PROWAG requirements?

Once these matters are settled, the plans shall address the following:

Controller and cabinet

- The traffic signal controller shall be a McCain ATC eX2 NEMA TS 2 Type 2, with eight-phase pad-mount cabinet. Communications modules, panels, wiring, and other incidentals compatible with the site-specific requirements (central system control, closed-loop system, etc.) shall be included. All components shall be installed per manufacturer specifications.
- The cabinet foundation shall include at least one spare 2-inch conduit.
- The contractor shall stake the location of signs, poles, pullboxes and signal cabinet prior to installation and shall contact Knox County Engineering and Public Works for approval. Any field adjustments shall require approval by Knox County.
- All traffic signal equipment shall be installed within the right-of-way or within a 10-foot drainage and utility easement. No exceptions will be permitted without written approval from Knox County.

- All equipment shall meet all National Electrical Manufacturers Association (NEMA) standards.

Signal timing and phasing

- Initial controller timing shall be provided before construction begins. Provide worksheets documenting calculation of yellow/all-red clearance intervals and pedestrian timing compliant with 2009 MUTCD, Sections 4D.26 and 4E.06.
- The contractor shall verify that phase omit, detector switching or other means approved by Knox County are in place to prevent the possibility of a “left-turn trap”. In some cases, flashing yellow arrow left-turn heads may address this issue.

Cabling and conduit

- All signal cable shall be International Municipal Signal Association (IMSA) approved cable:
 - Traffic signal cable shall be IMSA Specification 19-1, 12-conductor stranded wire for span-mount heads. Mast arm designs may use 5- or 7-conductor cables per TDOT standard drawing T-SG-12.
 - Pedestrian signal cable shall be IMSA Specification 19-1 5- or 7-conductor stranded wire per TDOT standard drawing T-SG-12.
 - Pedestrian push button cable shall be IMSA Specification 50-2 3- or 5-conductor stranded wire per TDOT standard drawing T-SG-12.
 - Detector loop lead-in cable shall be IMSA Specification 50-2 2-conductor stranded wire.
 - Loop wire shall be IMSA Specification 51-3, 1-conductor stranded wire.
- 12-conductor cabling for span-mount heads shall be terminated in 12-position quick-disconnect hangers as follows:

<u>Terminal #</u>	<u>Color</u>	<u>Terminal #</u>	<u>Color</u>
1	Green	7	Green striped
2	Orange	8	Orange striped
3	Red	9	Red striped
4	Blue	10	Blue striped
5	White striped	11	Black striped
6	Black	12	White

- Pullboxes shall not be spaced farther than 150 feet apart.
- All traffic signal equipment shall be installed within the right-of-way or within a 10-foot drainage and utility easement. No exceptions will be permitted without written approval from Knox County.

Vehicular heads and pedestrian heads and pushbuttons

- All traffic signal heads shall be tethered and shall have black aluminum housings with 5-inch louvered black aluminum backplates. All backplates shall have a 2-inch yellow retro-reflective strip around them to enhance conspicuity. Span-mount heads shall have 12-position quick-disconnect hangers. All displays shall have 12-inch lenses and shall be LED (light-emitting diode) type meeting the current minimum standards published by the Institute of Transportation Engineers. Incandescent or screw-in modules are not acceptable, and

compatibility with conflict monitors and load switches shall be tested and confirmed. Lenses shall be clear with color LEDs. Color lenses with white LEDs are not acceptable. Manufacturer shall provide a minimum five year warranty for operation of the unit.

- On any approaches within 40 degrees of due east or due west, Knox County shall require supplemental pole-mount heads to mitigate problems with sun glare and reflection.
- Signal heads for permitted/protected left-turn movements shall be 4-section with flashing yellow arrow.
- Arrows in vehicular signals shall be three-line. Pedestrian signals shall be filled (not outline) type and shall include clearance interval countdown displays.
- Pedestrian pushbuttons shall be vandal-proof 2-inch ADA compliant.
- Signal heads when visible to drivers but not operational shall be completely covered.

Detection

- Vehicle detection loops shall be 6 feet X 50 feet quadrupole design.
- When intersections with existing traffic signals are modified, non-intrusive vehicle detection (video, radar or other approved by Knox County) may be required to facilitate continual vehicle detection during various construction phases whereby lane locations are shifted.
- Vehicle loop detector amplifiers shall be shelf-mount only; no rack-mount units are allowed.

Signal supports

- The actual pole placement locations may vary from those shown on the plans. Therefore, the shaft lengths and location of span tie-in points may also vary depending on the ground elevation at the actual pole placement locations. ***Prior to ordering the signal poles the contractor shall determine ground line elevations, required shaft lengths, and required locations of span tie-in points and stake the pole locations in the field. The contractor, design engineer, affected utilities, and Knox County engineering staff shall meet in the field to review the proposed pole locations and resolve any conflicts prior to ordering and designing the poles.*** Upon the beginning of construction, if a signal pole location varies by more than two feet from the plan, new pole design or verification of design adequacy shall be required.
- Particular attention shall be given to pole locations so that full compliance with MUTCD, Section 4E.08 (Pedestrian Detectors) is accomplished where applicable.
- Signal heads shall have a minimum vertical clearance of 17.5 feet. For span-mount designs, the point of attachment is the elevation difference between the span tie-in point on the pole and the maximum pavement elevation under the span. The maximum sag for the span shall be 5%.
- Final design of poles, spans wire or mast arms, and foundations are the responsibility of the pole manufacturer and/or contractor. The signal plan designer shall include a table or figure of distances from poles to fixtures and fixture references (head #, sign #). This is to facilitate the pole design process so that the

pole designer is not required to estimate the fixture locations based on a scaled drawing.

- Each pole foundation shall include at least one spare 2-inch conduit.
- All traffic signal equipment shall be installed within the right-of-way or within a 10-foot drainage and utility easement. No exceptions will be permitted without written approval from Knox County.
- The contractor shall stake the location of signs, poles, pullboxes and signal cabinet prior to installation and shall contact Knox County Engineering and Public Works for approval. Any field adjustments shall require approval by Knox County.

Signs and pavement markings

- All pavement markings are to be thermoplastic and shall comply with applicable provisions of the TDOT Standard Specifications for Road and Bridge Construction, Sections 716 and 918.
- The contractor shall install stop bars.
- For new traffic signal installations, signs W3-3 with flags and “New” plate shall be installed on all approaches with the sign locations being in compliance with the MUTCD, Section 2C.05. Sign faces shall be minimum 3M “high intensity grade” or equivalent, and all sign materials and installation shall be in accordance with Section 713 of the TDOT Standard Specifications for Road and Bridge Construction.
- The contractor shall install street name signs on span wire or mast arms. Signs shall be minimum 3M “high intensity grade” or equivalent. Coordinate sign design with Knox County.
- The contractor shall remove conflicting existing STOP signs immediately after the signal is made fully operational and shall store them for pickup by Knox County.

Inspections

- If the signal contractor is other than Knox County’s signal maintenance contractor (Progression Electric, 865-971-5432), the signal contractor shall arrange for inspection of the new signal construction by Knox County’s signal maintenance contractor at the following milestones:
 - Pole foundation before pouring concrete
 - Conduit and pull boxes before cable is installed
 - Directional bored conduit installation
 - Vehicle loop detector installation
 - Controller cabinet and electrical service installation
 - Cable and heads installation
 - Fiber optic cable and communications installation
 - Final wiring and operation (timing, detection)
 - Coordination operation and timing
 - Final complete inspection

- The contractor shall notify Knox County (John Sexton, 865-215-5860) of the date and time of the project final inspection. This notification shall be given at least three business days prior to the inspection.
- The contractor shall contact Knox County Engineering and Public Works, one day prior to concrete placement and conduit placement to schedule inspector.

Utilities

- The locations of utilities and underground structures shown on the plans are approximate only and not all have been shown. The installer shall coordinate with utility and property owners as required to identify, relocate, and protect features as necessary prior to equipment installation. Some utilities can be located by calling the Tennessee One Call System, Inc. 1-800-351-1111.
- The contractor shall provide all necessary protective measures to safeguard existing utilities from damage during construction of the project. In the event that special equipment is required to work over and around the utilities, the contractor shall be required to furnish such equipment. The cost of protecting utilities from damage and furnishing special equipment shall be included in the price bid. The cost of any damage to utility facilities shall be borne by the installer.
- The contractor shall coordinate with the local electric utility with regard to providing electrical service connection and shall include a “courtesy disconnect” near the cabinet mounted on a wood post (4”x4” or 6”x6”).
- The contractor shall obtain and pay for all permits associated with electrical service.

Flash and full activation of new signals:

- New signals shall flash for a minimum of seven days and a maximum of fourteen days prior to full activation. Flashing operation shall not begin without Knox County’s approval.
- All final pavement markings and traffic signal equipment (including loops and communication infrastructure where applicable) shall be in place and operational before flashing operation begins.
- Full activation to stop-and-go operation shall take place on a Tuesday, Wednesday or Thursday only.
- Signal timing shall be provided to Knox County for review at least three business days before full activation occurs.

Traffic control

- Temporary traffic control devices and measures shall be provided during construction in full compliance with the latest edition of the MUTCD.
- Traffic control devices shall not be displayed or erected unless related conditions are present necessitating warning.

Miscellaneous other requirements

- The contractor shall provide as-built drawings to Knox County Engineering and Public Works if construction of the traffic signal deviates from the traffic signal plan.

- The contractor shall provide Knox County with copies of the paid invoices for all traffic signal equipment installed on this project.
- The contractor shall submit all shop drawings to Knox County Engineering and Public Works for approval prior to ordering all materials (including but not limited to conduit, pullboxes, cable, signal heads, backplates, poles, controller, signal monitor, vehicle detectors, controller cabinet, quick disconnects, signal brackets, and concrete).
- Any area disturbed during construction shall be restored to original condition or as acceptable by Knox County.
- The contractor shall have an IMSA Level II certified technician on-site during all construction of signal, upon the start of flashing operation, and at the implementation of full stop-and-go operation of the signal.

The following checklist is provided to help ensure that all required items have been shown in the traffic signal plans:

- Site location plan
- North Arrow on each sheet
- Graphic scale on each sheet where applicable (1"=20' or 1"=30' preferable, 1"=50' acceptable where necessary with Knox County approval)
- Legend
- Engineer's seal on all sheets
- Title blocks all complete
- Cover sheet complete with correct title and names correct
- Identify and locate existing and proposed:
 - Right-of-Way
 - Driveways
 - Utilities- Underground
 - Utilities- Overhead
 - Drainage structures
 - Curbs and/or edge of pavement (label roadways with name and/or state route designation)
 - Sidewalks and ramps
 - Guardrail
 - Pavement markings (lines, hatching, stop bars, crosswalks, text, arrows)
- Identify and locate existing traffic control components if applicable:
 - Poles
 - Mast arms or span wires
 - Cabling
 - Signal heads
 - Detector loops
 - Controller cabinet
 - Pull boxes conduits
 - Pedestrian heads and pushbuttons
 - Signs (post mounted or overhead)
- Document volume projection calculations and assumptions regarding driver actions (right turn on red, permissive left turns, etc.)

- Determine most appropriate phasing, cycle length and timing, and number of lanes if required
- Determine needed intersection improvements:
 - Additional pavement (turn lanes, etc.)
 - Medians or islands
 - Signing (post mounted or overhead)
- Locate proposed signs, edge of pavement (shoulder or curb-and-gutter), and pavement markings (utilize turning templates as required):
 - Lane lines
 - Stop bars
 - Crosswalks
 - Text
 - Arrows
 - Hatching
- Locate proposed signal hardware:
 - Poles
 - Mast arms or span wires
 - Cabling
 - Signal heads
 - Detector loops (including size, number of turns and mode)
 - Controller cabinet
 - Pull boxes
 - Conduits (standard or bored)
 - Pedestrian heads and pushbuttons
 - Components for communication if applicable (interconnect cable, radio units, antennas, etc.)
 - Special equipment (pre-emption, etc.)
- Check for conflicts with existing or proposed utilities
- Include signal head and sign details, phasing diagram, table of quantities, initial controller timing, detector connection and operation, wiring diagram, and span and pole data
- Include pertinent notes, details and specifications
- Include note describing controller and cabinet (make and model)
- Include special notes for construction area traffic control and utilities, including special signing needs