

DESIGN CRITERIA

DIVISION 4900 TRAFFIC SIGNALS

4901 GENERAL: These criteria shall be adhered to for the design of all publicly-financed or privately-financed traffic signal systems to be installed in the public street right-of-way or on other public property under the jurisdiction of the City of Shawnee, Kansas.

4902 DESIGN CRITERIA: The traffic signal system shall consist of the signal controller, signal poles, signal heads, cable, conduit, vehicle detectors and any other appurtenances required to provide a complete, operable traffic signal system. Components of the system shall conform to the City's Technical Specifications. Copies of the City Standard Plan and Detail Sheets are available through the Traffic Engineering Division or can be found on the City of Shawnee's website at www.cityofshawnee.org

.1 Codes and Standards: These criteria are established to provide uniform procedures to aid the design engineer in preparing improvement plans for projects in the City of Shawnee. These criteria are not intended to be an ironclad set of rules that restrict the design engineer from utilizing innovative design; however, they may be modified only with prior authorization of the City Project Engineer.

In addition to these requirements, all work shall conform to the requirements of the latest edition of the *Manual on Uniform Traffic Control Devices* (MUTCD).

.2 Standard Phasing: When designing a traffic signal whether it's an existing signal or a new signal, the signal phasing shall be discussed with the City in order to determine the number and sequence of the phases. The City uses a standard phasing sequence, which is shown below:

- Phase 1 – eastbound left
- Phase 2 – westbound through
- Phase 3 – southbound left
- Phase 4 – northbound through
- Phase 5 – westbound left
- Phase 6 – eastbound through
- Phase 7 – northbound left
- Phase 8 – southbound through

.3 Signal Heads: Traffic signal heads shall be placed in accordance with the MUTCD. In addition, some guidelines in an effort to standardize the placement of signal heads are below:

- A. Typically, a standard three-section head should be centered over each exiting lane for all through lanes of traffic.
- B. When a left-turn lane is provided without left-turn phasing, no separate signal head should be provided for the left-turn movement.
- C. When protected left-turn phasing is specified, the three-section head should typically be centered over the left-turn lane. Likewise, when dual left-turn movements are specified, a separate indication should be centered over each left-turn lane. In addition, a separate LEFT TURN SIGNAL sign (R10-10) shall accompany each indication.
- D. When protected/permissive left-turn phasing is specified, a four-section head should be placed over the extension of the channelization line between the left-turn lane and the adjacent through lane. The head shall be accompanied by a LEFT TURN YIELD ON symbolic green ball sign (R10-12).

All traffic signal and pedestrian indications shall be LED displays. In addition, backplates shall be provided for all traffic signal heads that are mounted to the mast arm. Signal heads that are mounted to the signal pole should not be equipped with backplates.

- .4 Emergency Preemption:** Opticom emergency preemption equipment shall be shown on the signal plan and shall be designed for ALL directions of traffic at an intersection.
- .5 Detector Loops:** Standard loop dimensions for stop bar detection include 6 ft. x 50 ft. Quadrapole (1.8 m x 15 m) detector loops. All advance detector loops shall be 6 ft. x 6 ft. (1.8 m x 1.8 m) detector loops.

In order to determine where to place a 6 ft. x 50 ft. (1.8 m x 15 m) stop bar detector loop, the City typically places the front of the loop 15 to 20 feet (4.5 to 6.0 m) from the nearest edge of the through lane of the intersecting road extended. Stop bar pavement markings should be properly designed so that a minimum of 2 ft. of vehicle detection loop extends past the stop bar.

When vehicle detector loops are used, advance detector loops shall be placed at standard distances. The table below lists these distances based on the posted speed limit. Please note the distances are measured from the back of the stop bar to the back of the loop.

Speed	Distance (ft) Back of 1 st Loop	Distance (ft) Back of 2 nd Loop	Distance (ft) Back of 3 rd Lp
35 mph	210'	N/A	N/A
40 mph	210'	260'	N/A
45 mph	210'	320'	N/A
50 mph	210'	380'	N/A
55 mph	210'	320'	485'

.6 Service Boxes: Service boxes shall typically be provided whenever conduit changes direction and adjacent to signal poles and controllers. Junction boxes should typically be used adjacent to detector loop locations for the splicing of loop wire to the lead-in cable. Type I junction boxes shall be used where one or two conduit runs enter/exit the box. Type II junction boxes shall be used where more than two conduit runs enter/exit the box. Service and junction boxes shall be installed at least 2 feet (0.6 m) from the back of curb to the center of the box and no closer than 2 feet (0.6 m) to any pole. The distance between service and/or junction boxes shall not exceed 200 feet to facilitate the pulling of cable.

.7 Conduit: All conduit for traffic signal installations shall be either Schedule 40 polyvinyl chloride (PVC) conduit or Schedule 40 high density polyethylene (HDPE) conduit. Signal conduit that extends from signal poles to adjacent service boxes should typically be 3-inch (75 mm) conduit while signal conduit that extends from the signal controller to the adjacent service box shall consist of two 4-inch (100 mm) conduits. Signal conduit that extends from service box to service box should be either 3-inch (75 mm) or 4-inch (100 mm) conduit, depending upon the number and size of conductors. Signal conduit for advance detector conduit runs should typically be 2-inch conduit while conduit for signal interconnect/fiberoptic cable should typically be 2-inch (50 mm) conduit.

Street lighting cable is permitted in signal conduit runs and boxes. The conduit sizes above are typical applications. The Engineer, however, shall verify that the signal conduit is properly sized so that no more than 40 percent of the conduit cross-sectional area is filled.

.8 Secondary Service: The Engineer shall coordinate and verify the location of the proposed secondary service point with the appropriate utility company to ensure availability of service. A conduit with a pull string shall extend from the controller to the secondary service point.

A 2-inch (50 mm) conduit shall be used when Kansas City Power & Light is providing the power; a 3-inch (75 mm) conduit shall be used when WestStar is providing the service.

.9 Signal Poles: Signal poles shall typically be located a minimum of 6 feet (1.8 m) from the back of curb to the center of the pole. When pedestrian signal heads are used, signal poles with push buttons should be placed at locations that are convenient to the pedestrian. However, the City does not require that poles be aligned with the crosswalk locations.

.10 Controllers: Controllers should typically be located adjacent to and behind the sidewalk or at least 10 feet (3.0 m) from the back of curb to the center of the controller where no sidewalk exists. In locations where no curb exists, the controller should typically be placed more than 10 feet (3.0 m) from the edge of pavement to the center of the controller if possible. When the location of the controller has been finalized and power has been verified with the utility company, the City will provide the Engineer with an address and an identification number for each proposed controller. The address and identification number shall be placed in the lower right corner of the traffic signal plan sheet above the title block.

.11 Wiring: The City has standardized the number of conductors required for the various types of traffic signal equipment.

Cable for vehicle signal heads should consist of 7-conductor cable while cable for pedestrian and pushbutton detectors should consist of 5-conductor cable. Typically, the City uses 1-7c per phase for the vehicle signal heads regardless of how many heads are on the mast arm or the signal pole. When pedestrian heads and pushbutton detectors are used, 1-5c cable should extend from the controller to the signal pole for the pedestrian head(s) and pushbutton detector(s) on the pole.

Detector lead-in cable should consist of 2-conductor shielded cable while detector loop wire should consist of single conductor PVC/nylon with tube jacket.

Street lighting distribution cable should consist of 2-1c No. 8 AWG while pole and bracket cable shall be No. 10 THHN 2-conductor stranded copper conforming to IMSA Specification 19-1. In addition, all street lighting cable for luminaires on signal poles should be spliced inside the signal pole, not the service box adjacent to the pole.

Fiber optic cable shall consist of a 12-fiber cable assembly which includes 6 single-mode and 6 multimode-graded fibers.

.12 Timings: The City has developed some guidelines that should be used when developing timings for a proposed traffic signal. They are as follows:

- A. Maximum Green: to be determined by the Consultant with Engineer review.
- B. Minimum Green: Typically 8 seconds for left-turn phases and 10 seconds for through phases.
- C. Walk: Typically 4 to 5 seconds
- D. Flashing Don't Walk: distance is measured from the back of curb to the far side of the traveled way and is then divided by 3.5 feet/second to obtain the Flashing Don't Walk time.
- E. Passage: Typically 1 second for through and left-turning phases
- F. Yellow Clear: should be determined using the methodology found in the latest edition of ITE's *Manual of Traffic Signal Design*. For protected/permissive and protected left-turn phases, use a 25 mph (40 km/h) speed limit for the calculations.
- G. Red Clear: should be determined using the methodology found in the latest edition of ITE's *Manual of Traffic Signal Design*. For protected/permissive and protected left-turn phases, use a 25 mph (40 km/h) speed limit for the calculations.

Phase Functions such as Vehicle Recall and Start-Up Green are typically the main street through phases.

In the Emergency Flash table, the indications for all applicable signal phases shall be RED while the indication for pedestrian phases shall be DARK.

In the Signal Output File Layout, the City prefers right-turn overlaps to be hard-wired. This is done by connecting the yellow and green arrows in the E_d Signal Head to appropriate field terminals.

.13 Video Detection: When video detection is used, the video detection system shall be manufactured by Econolite and shall be the Autoscope Solo Pro system. Typically, the video detector should be mounted to the luminaire arm that is attached to the traffic signal pole. When video detectors are used for advance detection, the video detectors should be mounted to the luminaire arms of street light poles within close proximity to the intersection. The manufacturer's representative shall be consulted to determine the proper placement of the video cameras. In addition to the video detectors, detection zones shall also be illustrated on the signal plan.

.14 Overhead Signs: Overhead street name signs shall be mounted to the mast arms using Astro-Brackets. There shall be a minimum of two brackets per sign placed no more than 3 feet (1 m) apart with a maximum of 1 foot (0.3 m) from the edge of the sign. Typically, the overhead street name signs should be placed between the signal pole and the first vehicle signal head.

.15 Traffic Signal Interconnect: At locations specified by the Engineer or where multiple Traffic Signals are to be constructed in close proximity, Interconnection of the traffic signals through fiber optics may be required. Refer to Division 2950 of the Technical Specifications for Traffic Signal Interconnect specifications.

4903 PLAN REQUIREMENTS: This section governs the preparation of improvement plans for a traffic signal project.

.1 General: The improvement plans shall include all information necessary to build and check the design of a traffic signal system. For new developments, the plans shall be submitted as a separate set, which clearly shows other public street and stormwater drainage improvements (and utilities, if applicable) in a de-emphasized manner. The plans shall be arranged as required by the Engineer. The title sheet for the plans shall be signed and sealed by a Kansas Registered Professional Engineer responsible for preparing the plans. The signed and sealed plans shall be submitted to the Engineer for review and approval prior to construction.

.2 Private Improvements: If any private improvements are shown on the public improvement plans, they shall be clearly defined and marked as such. An appropriate note shall be included on the drawings stating that these private improvements will not be maintained by the City of Shawnee.

.3 Sheet Size: The suggested sheet size for improvement plans is twenty-four inches by thirty-six inches (24" x 36") although sheets twenty-two inches by thirty-four inches (22" x 34") may be used. All sheets in a given set shall be the same size.

.4 Types of Sheets in Plans: The improvement plans shall consist of the following:

- Title Sheet
- Traffic Signal Plan Sheet
- Wiring Detail and Timing Plan Sheet
- Summary of Quantities Sheet
- Standard Detail Sheets
- Pavement Marking and Signing Plan and Detail Sheets
- Traffic Control Detail Sheet

Each sheet shall contain proper project identification, the type of sheet, a sheet number, including the individual sheet number and the total number of sheets, and dates of when the plans were originally prepared and all revisions. Copies of the approved standard plan sheets can be obtained from the Traffic Engineering Division or on the City of Shawnee's website at www.cityofshawnee.org

.5 Required Information for Title Sheet: The title sheet shall include the following information:

A. The project title in ½-inch lettering, centered at the top of the sheet as follows:

TRAFFIC SIGNAL IMPROVEMENTS
(Name of Development, Street, Etc.)
(City Project Number, When Applicable)
CITY OF SHAWNEE, KANSAS

- B. An index of the sheets included in the plans.
- C. A list containing the name and telephone number of each utility company and the State One-Call System.
- D. An approval block for the signature of the representative of the appropriate electrical utility company approving the control center location and the date of such approval.
- E. An address block for the control center.
- F. The name, address, and telephone and fax numbers of the design engineer.
- G. The name, address, and telephone and fax numbers of the owner/developer, where applicable.

- H. The project control bench marks shall be identified as to location and elevation based on NGVD Datum.
- I. A vicinity map adequately showing the project location in relation to major streets and the section in which it is situated, with a north arrow and at a scale of one inch (1") equals two thousand feet (2000').
- J. A signature block to be signed and sealed by the Kansas Registered Professional Engineer responsible for preparing the plans.
- K. An approval block for the signature of the Engineer and the date of such approval. The approval block shall be as follows:

APPROVED BY THE CITY OF SHAWNEE

BY: _____ DATE: _____

City Traffic Engineer

.6 Required Information for Traffic Signal Plan Sheet: The traffic signal plan sheet shall include the following information:

- A. A legend of symbols shall be shown that apply to all sheets. The legend may be shown on the title sheet if room permits.
- B. One or more plan sheets adequately showing the traffic signal system in relation to the streets and adjacent properties, with a north arrow, and a bar scale at a minimum scale of one inch (1") equals fifty feet (50'), unless a larger scale is specified by the Engineer.
- C. All existing and proposed utilities such as power, gas, water, telephone, cable, sanitary sewer, storm sewer, and other items shall be accurately shown according to the best available information in the records of the owner of the facility, or field location, and shall be identified as to type, size, material, etc., as may be applicable.
- D. All existing and known proposed improvements within fifty feet (50') each side of the right-of-way and one hundred feet (100') beyond the project limits shall be shown at their proper locations unless otherwise approved or required by the Engineer. These improvements shall include items such as street pavement, curbs and gutters, sidewalks and driveways, storm and sanitary sewers, water mains and fire hydrants, utility poles and pedestals, trees and shrubs, fences and walls, buildings, and similar items, and shall be identified as to type, size, material, etc., as may be applicable. Irrelevant items may be omitted for new developments.

- E. Street centerline stations shall be marked at one hundred-foot (100') intervals and at other pertinent points.
- F. The plans shall clearly show the proposed placement of all traffic signal equipment including; poles, heads, opticom, cameras, signs, street lights, junction and service boxes, conduit, loops, and control centers. The items to be constructed or installed for the project shall be legibly noted and located by station and offset.
- G. A signal phasing diagram shall be displayed and shall follow the City's standard phasings.
- H. A list of general notes to the contractor including at least the following:

GENERAL NOTES

1. Existing underground (U/G), overhead (O.H) utilities and drainage structures have been plotted from available information and therefore, their locations must be considered approximate only. It is the responsibility of the individual contractors to exactly locate each utility before actual construction.
2. All construction methods and traffic signal equipment shall conform to the latest edition of the City of Shawnee Standard Specifications.
3. Contractor shall stake the location of all traffic signal poles, conduit, controllers, service boxes and junction boxes to be installed. The stations and offsets provided are to the center of the traffic signal equipment. The Project Engineer shall inspect the staking prior to any excavation and/or construction. Minor relocation of equipment to avoid conflicts may be allowed with the approval of the Project Engineer.
4. All existing curb and gutter, sidewalk, pavement, drainage structures or ground damaged during the traffic signal construction shall be replaced to match existing. This work will be considered SUBSIDIARY to the "Traffic Signal Installation" bid item..
5. Factory conduit bends shall be installed into service boxes, junction boxes and/or pole bases from conduit runs. Conduit entering service boxes, junction boxes and/or pole bases shall be continuous in the service boxes, junction boxes and/or pole base.
6. Coordinate Signal Turn-On with the City of Shawnee.
7. All traffic signal indicators shall be L.E.D. (Light Emitting Diode).

.7 Wiring Detail and Timing Sheet: The most current detail sheets may be obtained from the Traffic Engineering Division or the City's website. The Wiring Diagram should consist of an overall schematic of the Traffic Signal system as well as wiring diagrams for each pole. The Engineer is expected to provide signal timings formatted accordingly to the detail sheet. The following notes should be included on the wiring diagram:

Notes:

1. All wire shall be #14 A.W.G. unless otherwise noted.
2. A 1c#6 bare copper ground wire and pull string shall be run through the system.

.8 Summary of Quantities Sheet: Substitutions for equipment not on the latest approved standard sheet may be made.

.9 Remaining Detail Sheets: Revisions to all other detail sheets may only be made with approval of the Engineer representative from the City.