

**SECTION 5900 – TRAFFIC SIGNALS**  
**CITY OF LEE’S SUMMIT, MISSOURI**  
**DESIGN CRITERIA**

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## TRAFFIC SIGNALS

**5901 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 Lee's Summit, Missouri.

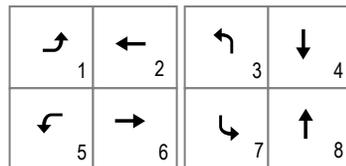
**5902 DESIGN CRITERIA:** The traffic signal system shall consist of the signal controller, signal poles, signal heads, cable, conduit, detection, communication equipment, and any other appurtenances required to provide a complete, operable traffic signal system. Components of the system shall conform to the City's Technical Specifications. Equipment used shall be from the City's Approved Products List. Copies of the City Standard Plan and Detail Sheets, as well as the Approved Products List, are available through the Traffic Engineering Division.

**5902.1 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 Lee's Summit. 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 Traffic Engineer.

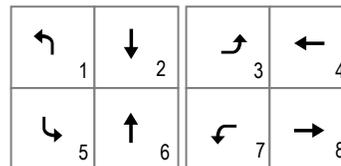
In addition to these requirements, all work shall conform to the requirements of the latest edition of the *Manual on Uniform Traffic Control Devices* (MUTCD).

**5902.2 Signal Phasing:** When designing a traffic signal (new installation or modification), the signal phasing (number and sequence of the phases) shall be discussed with the City. Traffic signal phasing will be illustrated on the plans using a NEMA diagram (examples below). The City uses two standard phasing sequences, depending on whether the main-street/coordinated movements are north-south or east-west:

**East-west street is coordinated/major**



**North-south street is coordinated/major**



**5902.3 Signal Heads:** All vehicular traffic signal heads shall be 12 inches in diameter. 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. A separate LEFT TURN SIGNAL sign (R10-10) shall accompany each indication.
- D. When protected/permissive left-turn phasing is specified, a five-section head should be placed over the extension of the channelization line between the left-turn lane and

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the adjacent through lane. The head shall be accompanied by a LEFT TURN YIELD ON symbolic green ball sign (R10-12).

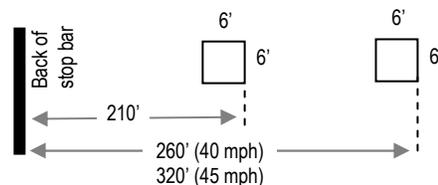
These placement criteria are to be used as guidance by designers. Special situations may arise in which alternate arrangements are appropriate. Deviations from the above criteria must be approved by the City Traffic Engineer. See also Section 5902.10 for information on mounting heads to mast arms.

All traffic signal and pedestrian indications shall be LED. Pedestrian signals should include countdown 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 will be evaluated for backplates on a case-by-case basis.

**5902.4 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, with the possible exception of private drives. Generally, Opticom discriminators should be placed on far-side mast-arms.

**5902.5 Video Detection:** Unless otherwise specified by the City Traffic Engineer, video detection should be used for stop bar detection at all signal installations. The video detection system shall be per the City Approved Products List. Typically, one camera per approach will be used, unless special needs dictate otherwise. The camera should typically be mounted to the luminaire arm that is attached to the traffic signal pole. If there is no luminaire arm, the camera should be mounted to the signal mast arm via a six-foot riser arm. The manufacturer's representative shall be consulted to determine the proper placement of the video cameras; and documentation shall be obtained from the manufacturer's representative indicating that the placement is acceptable. In addition to the video detectors, detection zones should also be illustrated and numbered on the signal plan. Detection zones are typically shown 6' x 50', centered in the lane, with the leading end of the zone two feet in advance of the stop line.

**5902.6 Detector Loops:** Typically, detector loops should only be used for advance detection, and should be 6 feet x 6 feet, centered in the lane. Advance detector loops should only be used on streets with posted speeds of 40 mph or more, and should be placed at standard distances as illustrated in the diagram at right (measured from the back of the stop bar to the back of the loop).



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**5902.7 Traffic Signal Boxes:** Pull boxes should typically be provided whenever conduit changes direction and adjacent to signal poles and controllers. Pull boxes should typically be used adjacent to detector loop locations for the splicing of loop wire to the lead-in cable. The type of box used is based on the number of conductors entering the box, as shown in the table at right. Pull boxes should be installed at least 1 foot 6 inches from the back of curb to the center of the box and no closer than 2 feet to any pole. The distance between traffic signal boxes should not exceed 200 feet to facilitate the pulling of cable.

**Box Type Criteria**

Conductors entering box	Required Box Size
0 - 22	17"W x 30"L x 22"D (Class 1)
23 - 68	24"W x 36"L x 26"D (Class 2)
> 68	30"W x 48"L x 36"D (Class 3)

Traffic signal box lids (including interconnect) shall be labeled "TRAFFIC SIGNALS".

**5902.8 Conduit:** All conduit for traffic signal installations shall be either Schedule 40 polyvinyl chloride (PVC) conduit or Schedule 40 high density polyethylene (HDPE) conduit, except for conduit that will remain exposed (such as an above-ground run to the power supply), which should be rigid metal.

Signal conduit that extends from signal poles to adjacent pull boxes should typically be a minimum 3-inch conduit, while signal conduit that extends from the signal controller to the adjacent pull box should consist of two 4-inch conduits. Any conduit crossing the street should be a minimum of 4 inches. Signal conduit for advance detectors and interconnect cable should typically be 2-inch conduit.

**Typical Conduit Sizes**

signal poles to adjacent boxes	3"
controller to adjacent pull box	2-4"
street crossing	4"
advance detection	2"
interconnect	2"

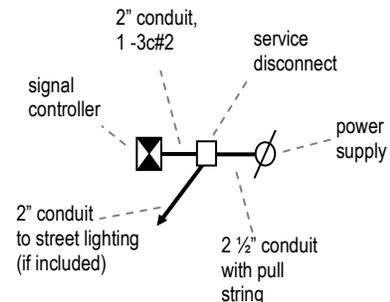
Street lighting cable is permitted in signal conduit runs and boxes. The conduit sizes above are typical applications. No street lighting cable should run through (or terminate in) the traffic signal controller cabinet.

At new installations where interconnect is **not** required, an additional 2-inch conduit run from the controller to the adjacent pull box (with pull string) should be included for potential future interconnect.

The Design Engineer shall verify that the signal conduit is properly sized so that no more than 40 percent of the conduit cross-sectional area is filled. For estimating conduit quantities, center-to-center distances should be used.

**5902.9 Power Supply:** The Design Engineer shall coordinate and verify the location of the proposed power supply with the appropriate utility company to ensure availability of service.

A service disconnect should be located between the controller and the power supply. The service disconnect should be located as close to the power supply as possible. A 2-inch conduit with a pull string should extend from the power supply to the service disconnect, and a 2-inch conduit with a 3-conductor cable should extend from the service disconnect to the signal controller. See the diagram at right.



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**5902.10 Signal Poles:** Signal poles shall typically be located a minimum of 6 feet from the back of curb (or edge of pavement, where there is no curb) to the center of the pole. However, no signal pole, pole base, or appurtenance shall be located within 2 feet of the face of curb or edge of shoulder. Signal poles shall typically not be located in a median or channelizing island. When pedestrian signal heads are used, signal poles with push buttons should be placed at locations that comply with, to the extent possible, with all Americans with Disabilities Act (ADA) provisions. At a maximum, the push button should be located within 5 feet of the crosswalk extended; within 10 feet of the edge of curb, shoulder or pavement at its closest point; and be accessible. This may require the use of pedestrian push button pedestals. The City does not require that signal poles be aligned with the crosswalk locations. However, the pedestrian heads shall be visible for pedestrian traffic.

Pole foundations, except pedestals, should be flush-mounted Type B except in locations without curb and locations where the posted speed limit is greater than 45 mph. At these locations, a Type A foundation (with a conical base that extends above ground) should be used, unless otherwise required by maximum bolt pattern described on the standard drawings. All pole foundations, except pedestals, at an intersection shall be of the same Type.

Astrobrackets (not prefabricated nipples) should be used for attaching signal heads to poles.

**5902.11 Controller Cabinet Assembly:** Controller Cabinets should typically be located adjacent to and behind the sidewalk or at least 10 feet 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 from the edge of pavement to the center of the controller if possible.

Master controllers shall be provided as part of all closed loop systems at the direction of the City.

The controller type and manufacturer shall be per the City's Approved Product List. The controller should be delivered to the City in advance of installation for programming. A note regarding delivery to the City should be on the plans.

**5902.12 Wiring:** The City has standardized the number of conductors required for the various types of traffic signal equipment.

Vehicle signal heads should be fed by 7-conductor cable. Typically, the City uses two cables per through phase and one per left-turn phase for the vehicle signal heads, regardless of how many heads are on the mast arm or the signal pole. The first through-phase cable terminates at the head mounted on the pole shaft, and the second through-phase cable extends to the end of the mast arm, with the mast arm through heads being fed by jumpers.

Pedestrian signal heads and pushbutton detectors, when used, should be fed by separate cables extending from the controller to the signal pole: one 5-conductor for each pedestrian head on the pole, and one 2-conductor for each pushbutton detector on the pole.

Detector lead-in cable (for advance detection) should consist of 2-conductor shielded cable. Detector loop wire should consist of single-conductor PVC/nylon with tube jacket.

Interconnect cable should be copper twisted pair (3), unless otherwise directed by the City Traffic Engineer (or designee).

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Street lighting cable for traffic signals should typically consist of 1-2c No. 8 AWG wire from the power supply to the luminaire. Street lighting cable for luminaires on signal poles should be spliced inside the pull box adjacent to the pole. If street light poles are integrated with the traffic signal system the street light poles should have break-away accommodations and be wired according to the street lighting standards and specifications.

Location	Slack (each cable)
pull-box: pass-through	6'
pull-box: termination controller	3'
vehicular signal head	8'
pedestrian signal head	13'
pedestrian pushbutton	10'
service disconnect	9'
	12'

In estimating quantities, cable slack should be computed according to the table at right.

The City prefers right-turn overlaps to be hard-wired. This is done by connecting the yellow and green arrows in the signal head to appropriate field terminals.

Splicing of cables will not be allowed.

**5902.13 Timing:** Traffic signal timings will be provided by the City Traffic Engineer and will **not** be shown on the plans.

**5902.14 Overhead Signs:** Typically, the overhead street name signs should be placed between the signal pole and the first vehicle signal head. On major arterial streets, commercial collector streets, and within the downtown area, internally illuminated street-name signs may be used, in consultation with the City Traffic Engineer.

The designer will compute the sign dimensions and show them on the plans. Lettering sizes are included in the City's standard plans.

**5902.15 Traffic Signal Interconnect:** At locations specified by the City Traffic Engineer or where a new traffic signal is to be constructed within a half-mile of a new or existing traffic signal, interconnection of the traffic signals (see Section 5902.11) is typically required. Box labeling and spacing should be as per Section 5902.7.

At new installations where interconnect is not required, future interconnect conduit should be installed as per Section 2.8.

**5903 PLAN REQUIREMENTS:** This section governs the preparation of improvement plans for a traffic signal project.

**5903.1 General:** The traffic signal plans shall include all information necessary to build and check the design of a traffic signal system. For new developments, the traffic signal plans shall be submitted with the public improvement plans (if any) and shall clearly show public street and stormwater drainage improvements and utilities in a de-emphasized manner. The plans shall be arranged as required by the City. The title sheet for the plans shall be signed and sealed by a Missouri Registered Professional Engineer responsible for preparing the plans. The signed and sealed plans shall be submitted to the City for review and approval prior to construction.

**5903.2 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 Lee's Summit. This section is not intended to imply that private improvements will be

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allowed within the public right-of-way.

**5903.3 Sheet Size:** The sheet size for improvement plans is twenty-two inches by thirty-four inches (22"x34"). Full-size and half-size plans are required for all submittals. All sheets in a given set shall be the same size.

**5903.4 Types of Sheets in Plans:** The improvement plans shall typically consist of the following sheets:

- Title Sheet
- General Notes and Legend Sheet
- Traffic Signal Plan Sheet
- Interconnect Plan Sheet (if needed)
- Wiring Sheet
- Equipment Quantities Sheet
- Pavement Marking and Signing Plan (if needed)
- Traffic Control Plan (if needed)
- Special Detail Sheets (if needed)
- Standard Detail Sheets
- Survey Plan Sheet(s) (if needed)

Each sheet should 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. See the City's example signal plan set for reference.

City Standard details should be included in the plan set.

**5903.5 Title Sheet:** The title sheet shall include the following information:

A. The project title, centered at the top of the sheet as follows:

**CITY OF LEE'S SUMMIT, MISSOURI  
PUBLIC WORKS DEPARTMENT  
TRAFFIC SIGNAL INSTALLATION  
(Name of Intersection)  
(City Project Number, Bid Number When Applicable)**

The City logo shall appear to the left of the project title.

- B. An index of the sheets included in the plans.
- C. A list of applicable City Standard Details, Legend, General Notes. (As Needed)
- D. A list containing the name and local telephone number of each utility company and the State One-Call System.
- E. The name, address, and telephone and fax numbers of the design engineer.
- F. The name, address, and telephone and fax numbers of the owner/developer, where applicable.

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- G. 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 approximate scale.
- H. A signature block to be signed and sealed by the Missouri Registered Professional Engineer responsible for preparing the plans.
- I. An approval block for the signature of the City and the date of such approval. The approval block shall be as follows:

Approved \_\_\_\_\_ Date: \_\_\_\_\_ 20\_\_  
City Traffic Engineer

- J. Note that traffic volume information need not be shown in the plans unless required by another reviewing agency (e.g., MoDOT).

**5903.6 General Notes and Legend Sheet:** See the City's example signal plans for a sample sheet. The general notes and legend sheet shall include the following information:

- A. A list of general notes to the contractor.
- B. A legend of symbols that apply to all sheets.
- C. Project specific notes.

**5903.7 Traffic Signal Plan Sheet:** See the City's example signal plans for a sample sheet. The traffic signal plan sheet shall include the following information:

- A. 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 twenty feet (20'), unless a larger scale is specified by the Engineer.
- B. 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. Existing utilities should be shown in gray.
- C. 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. Existing items should be shown in gray. New non-signal items may be shown with a thin black line. Future non-signal items may be shown with a dashed line.
- D. Pole locations. Typically, signal equipment does not need to be identified by station and offset unless stationing is available. If the signal is part of an improvement project for which stationing and controls have been developed, street centerline stations should be shown and marked at one hundred-foot (100') intervals for consistency between the signal and improvement plans. Pole locations should be

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referenced from the curb or pavement edge using a schematic location diagram on the signal plan sheet (see City example signal plans) and with station and offset when available.

The plans should clearly show the proposed placement of all traffic signal equipment including; power supply assembly, power source, poles, heads, opticom, cameras, signs, street lights, junction and service boxes, conduit, loops, and controller cabinet. The items to be constructed or installed for the project should be legibly noted.

**5903.8 Interconnect Plan Sheet (if needed):** If interconnect to an adjacent signal (or signals) is part of the design, a separate interconnect plan may be included. This plan should be at a minimum scale of 1 inch = 60 feet and should identify all conduit and boxes necessary to provide a complete interconnect system. The plan should also include notes (and details, if necessary) identifying how connections will be made in each controller. The plan should include a quantity table indicating total length of conduit and wiring; as well as the total number of boxes.

Interconnect cable should be included in the Wiring Diagram on the Wiring Sheet (see Section 3.9). Interconnect conduit and boxes should **not** be included on the Equipment and Quantities sheet, but an asterisked (\*) note should be included there, directing the reader to the Interconnect Plan Sheet.

**5903.9 Wiring Sheet:** See the City's example signal plans for a sample sheet. This sheet should include the following information:

- A. A Wiring Diagram (an overall schematic of the traffic signal system, including interconnect if any).
- B. A NEMA signal phasing diagram and sequence diagram should be displayed and should follow the City's standard phasings (see Section 2.2).
- C. A table of output file assignments.
- D. A table of flash operations
- E. A table for power supply information.

**5903.10 Equipment Quantities Sheet:** See the City's example signal plans for a sample sheet. This sheet should contain a Posts Table, a Traffic Signal Bases and Boxes Table, a Cable and Conduit Table, a Signal Heads Table, a Controller and Misc. Equipment Table, and a Signs Table. If there are no other quantity sheets as part of the plan submittal, a Pavement Marking Table, and Traffic Control Table may also be included.