

STATE	PROJECT NO.	YEAR	SHEET NO.	TOTAL SHEETS
KANSAS	87 N-0673-01	2017	91	99

**3.2.3.11. SURGE PROTECTOR.** The surge protector shall be a filtering surge protector that absorbs power line noise and switching transients, and provides lightning protection. It shall consist of three basic sub circuits: primary clamp, secondary clamp, and the filter. It shall be rated for a peak current of 20,000 amps from an 8 by 20 microsecond wave shape. The clamp voltage shall never exceed 280 Volts during a peak surge. It shall provide a maximum of 10 amps continuous service current at 120 Volts AC and 60 Hertz. It shall have an operating temperature range of -40 to +85 degrees Celsius. The filter shall be designed to absorb power line noises in the range of 10 kilohertz to 20 Megahertz.

**3.2.3.12. DC ISOLATOR.** The DC isolator shall meet the requirements of a Model 242 two-channel DC isolator per Chapter 5 Section 4 of the TEES.

**3.2.3.13. AC ISOLATOR.** When called for in the Plans, the AC isolator shall meet the requirements of a Model 252 two-channel AC isolator per Chapter 5 of the TEES.

### 3.2.4. DETECTION SYSTEMS.

**3.2.4.1. LOOP DETECTORS.** Loop detector sensor units provided shall, as a minimum, meet the specifications given in NEMA Standards Section 6.5 or TEES Chapter 5 Section 2 for NEMA Traffic Controller Assembly or Type 170E/2070 Traffic Signal Control Systems, respectively. In addition, the following features shall be included: push-wheel or push button switch to allow selection of a minimum of 8 pulse sensitivities, 7 presence levels and an "off" mode per channel; open loop test switch that displays previous faults on channel indicators while continuing to process and output valid detections; multiple channel sequential scanning; an inductance range of 20-2000 microhenries.

**3.2.4.2. VIDEO DETECTION SYSTEM (VDS).** Shall be capable of providing presence only vehicle detection at the intersection(s) using tripline or stop bar detection zones. All material furnished and installed under the VDS bid item shall be new and corrosion resistant. The VDS shall be expandable without removing or replacing existing units. VDS shall provide medium resolution and real time video detection image sensors (within 0.1 second of vehicle arrival).

**3.2.4.2.1. VDS CAMERA.** Shall be furnished by the video detection processor (VDP) supplier and shall be qualified by the supplier to ensure proper system operation. The camera shall produce a useable video image of the vehicles under all roadway lighting conditions, regardless of time of day but not less than the range 1.0 lux to 10,000 lux. Camera shall be digital signal processor (DSP) based and shall use a 0.25 or 0.33 inch view hole CCD sensing element with an infrared filter. Output color video with resolution of not less than 400 TV lines shall be provided. The CCD imager shall have a minimum effective area of 768(h) x 494(v) pixels conforming to NTSC/RS 170. The projected area shall be 2.5 square feet or less with a maximum weight of 30 lbs. The camera shall include an electronic shutter control based upon average scene luminance and shall be equipped with an auto-iris control lens that operates in tandem with the electronic shutter. The camera shall include a variable focal length lens with variable focus that can be adjusted, without opening the camera housing, to suit the site geometry.

**3.2.4.2.2. CAMERA HOUSING.** The camera housing shall be waterproof and dust-tight meeting NEMA 4 and IP 66 or above, standards. Provide a camera housing with a sun shield to minimize solar heating. The housing shall maintain an ambient temperature range of -30° F to +140° F while exposed to precipitation as well as direct sunlight. The camera housing shall have rotation of the camera horizon in the field during installation. Housing shall have at the rear a connection for power and video signal cables fabricated at the factory. A heater at the front of the enclosure to prevent the formation of ice and condensation shall be provided. When operating in the camera housing with power and video signal cables connected, the image sensor must comply with FCC Class B requirements for electromagnetic interference emissions.

**3.2.4.3. RADAR DETECTION SYSTEM (RDS).** May be used for either advanced detection or presence detection if approved by the owning municipality. The radar detection system may be a multi-sensor system or a single-sensor system. When using a combination system video/radar detection the video detection specifications shall still apply. A complete detection system including all mounting hardware, contact closure input card and necessary materials for a fully functioning system meeting manufacturers' specifications shall be included. The format of the interface module shall comply with NEMA or California TEES.

**3.2.4.3.1. PRESENCE RDS.** Presence Radar shall have a minimum detection range of 100 feet with a 90 degree field of view. The radar detection system shall provide at least 8 RF channels to mount multiple units in the same vicinity without causing interference between them. Radar sensor shall be able to detect vehicles in 1 to 6 lanes of traffic. The Presence RDS is required to have automatic and manual configuration of lanes, stop bars, and zones.

**3.2.4.3.2. ADVANCE RDS.** Advanced Radar shall have a minimum detection range of 600 feet. Object speed detection shall be with a range of 0 to 99 miles per hour. The radar detection system shall provide at least 8 RF channels to mount multiple units in the same vicinity without causing interference between them. Radar sensor shall be able to detect vehicles in 1 to 4 lanes of traffic as a minimum.

**3.2.4.3.3. RADAR HOUSING.** Radar housing shall be a weather tight sealed enclosure conforming to I-67, UL 746C and NEMA 250 Standards. The housing shall be resistant to corrosion, fungus, moisture deterioration and ultraviolet rays. The housing shall permit the radar to be adjusted to allow proper alignment for accurate operations. The maximum mounting height shall not exceed 40 feet.

**3.2.4.3.4. CABLE.** Power cable shall be sufficient with a minimum of 22 gauge for transmitting the required power. In cases where cable runs could exceed 1000' (feet), an 18 gauge cable may be necessary to ensure sufficient power without significant loss of power.

### 3.2.5. SIGNAL HEADS.

**3.2.5.1. STANDARD VEHICLE TRAFFIC SIGNAL HEADS.** All signal heads on a project shall be light emitting diodes (LED) and the product of one manufacturer with the exception of optically limited signal heads and one piece pedestrian signal heads. The signal heads shall be in general conformance with the latest edition of the ITE "Vehicle Traffic Control Signal Heads: LED Circular Signal Supplement" and as specified below.

**3.2.5.1.1. TRAFFIC SIGNAL HEAD HOUSING.** The housing for each vehicle traffic signal section shall be made of a durable polycarbonate. The housing shall be yellow with black doors. The visors for each signal section shall be of the tunnel type, and be made of a durable black polycarbonate of not less than 3/32 of an inch thick. The reflectors shall be of either specular aluminum or metalized plastic. All lenses shall be 12 inch diameter glass.

**3.2.5.1.2. ARROW MODULE.** When specified in the Plans, LED lenses shall meet the most current ITE "Vehicle Traffic Control Signal Head: LED Vehicle Arrow Traffic Signal Supplement" publication. The arrow may be formed of either enamel baked or fired onto the glass lens, or an arrow shield placed behind the lens. The arrow shield shall only allow light through the arrow display, with no extraneous light around the edges.

**3.2.5.1.3. LED MODULE.** When specified in the Plans, the lenses in each signal head shall be a 12 inch LED lens meeting the requirements of the most current ITE "Vehicle Traffic Control Signal Heads: LED Circular Signal Supplement" publication.

**3.2.5.2. PEDESTRIAN TRAFFIC HEADS.** The pedestrian traffic signal heads shall be of one piece polycarbonate or cast aluminum construction. The housing shall be yellow with black doors. The visors on the one piece heads shall be black, and be of the eggcrate type with a depth of 1.5 inches and a thickness of 0.03 inch. The pedestrian signal indications shall be in general conformance with the latest edition of the ITE Pedestrian Traffic Control Signal Indicators - Light Emitting. Pedestrian lenses shall be rectangular, with a side dimension of 12 inches, or with dimensions of 18.5 inches wide by 18.75 inches high. The message shall consist of a Don't Walk "HAND" symbol in Portland Orange, and a Walk "WALKING PERSON" symbol in Lunar White. The pedestrian symbols shall be a minimum of 9 inches high. The lenses shall be of a molded prismatic glass. The indication shall be formed on the lenses in the same manner as specified for arrows.

**3.2.5.2.1. COUNTDOWN PEDESTRIAN TRAFFIC CONTROL SIGNAL LENSES.** A one-section pedestrian signal head lense shall be rectangular, and have a side dimension of 16 inches and a width of 18 inches. The pedestrian symbols shall be a minimum of 6 inches high in accordance with the 2009 MUTCD. Where crosswalks are more than 100 feet from the pedestrian signal head, the symbols shall be a minimum of 9 inches high. The message shall consist of an upraised hand (symbolizing DON'T WALK) "HAND" symbol, and a Walk "WALKING PERSON" symbol. The upraised hand symbol shall be Portland Orange, and the walking person shall be White, with both indications conforming to the publication, "Pedestrian Traffic Control Signals Indications". Countdown pedestrian signals shall always be displayed simultaneously with the flashing upraised hand (symbolizing DON'T WALK) signal indication displayed for the crosswalk. The countdown pedestrian signals will consist of Portland Orange numbers that are at least 6 inches in height on a black opaque background. Where crosswalks are more than 100 feet from the pedestrian signal head, the symbols shall be a minimum of 9 inches high. The countdown shall be located immediately adjacent to the associated upraised hand. The countdown will further be in accordance with the latest edition of the MUTCD Section 4E.07.

**3.2.5.2.2. LED PEDESTRIAN SIGNALS.** Light Emitting Diodes (LED) Pedestrian Signals shall meet all applicable standards in the latest edition of the ITE "Pedestrian Traffic Control Signal Indicator: LED Signal Modules". The symbol designs shall conform to those set forth in the "Standard Highway Signs and Markings" book. These signal indications shall be consistent with KDOT Specification 3.2.5.2.1 "COUNTDOWN PEDESTRIAN TRAFFIC CONTROL SIGNAL LENSES". The module display shall have an overlaid symbol configuration. Signal modules must be moisture and dust resistant. Signal modules shall operate in an 80 VAC RMS to 135 VAC RMS Voltage range, (60 ± 3 Hz AC).

**3.2.5.2.3. ACCESSIBLE PEDESTRIAN SIGNALS (APS).** APS shall be installed at all signalized intersections where pedestrian infrastructure is present or to be constructed. The 2009 Manual of Uniform Traffic Control Devices (MUTCD) shall be the standards and guidance for APS and APS detector (pushbutton) placement in Section 4E.09 through 4E.13. APS volume control shall automatically adjust in response to ambient sound levels as required by the current MUTCD, Section 4E.11. (02) "Accessible pedestrian signals shall have both audible and vibrotactile walk indications." (03) "Vibrotactile walk indications shall be provided by a tactile arrow on the pushbutton (see Section 4E.12) that vibrates during the walk interval." (04) "Accessible pedestrian signals shall have an audible walk indication during the walk interval only. The audible walk indication shall be audible from the beginning of the associated crosswalk." (05) "The accessible walk indication shall have the same duration as the pedestrian walk signal except when the pedestrian signal rest in walk." (07) "Where two accessible pedestrian signals are separated by a distance of at least 10 feet, the audible walk indication shall be a percussive tone. Where two accessible pedestrian signals on one corner are not separated by a distance of at least 10 feet, the audible walk indication shall be a speech walk message." (08) "Audible tone walk indications shall repeat at eight to ten ticks per second. Audible tones used as walk indications shall consist of multiple frequencies with a dominant component at 880 Hz."

**3.2.5.3. OPTICALLY LIMITED SIGNAL HEADS.** The housing for optically limited signal heads shall be constructed of a durable polycarbonate. They shall be yellow, with black doors. Each section shall be provided with a black sheet aluminum sun visor.

**3.2.5.3.1. OPTICALLY LIMITED SIGNAL LENSES.** The visibility of the signal indication shall be adjustable within the signal head to fit the lane or lanes in which traffic is to be controlled. During daylight, the signal indications shall be visible only

in those areas or lanes designated. During dusk or darkness, a faint glow visible to the side will be permissible. External illumination shall not cause a signal indication, nor shall a signal indication in one signal section cause a signal indication in another signal section. Each section of a signal face shall provide a nominal 12 inch diameter round indication or arrow indication meeting the Institute of Transportation Engineers' dimensions as required.

**3.2.5.3.2. PROGRAMMING.** The indication of each signal head, when not programmed, shall be visible from anywhere within 15 degrees of the optical axis. The signal head shall be able to be preset at angles between 10 degrees above and 10 degrees below the horizontal, and shall be preset at 4 degrees (side-of-pole) or 8 degrees (mast arm) below the horizontal.

### 3.2.6. SIGNAL MOUNTING BRACKETS.

**3.2.6.1. MAST-ARM BRACKET.** The mast arm signal mounting brackets shall be fabricated of high strength aluminum. They shall provide for rigid mounting of the traffic signal heads while allowing signal aiming adjustment in all planes. The brackets shall be designed to strap to the mast arm using heavy-duty stainless steel banding material or aircraft-type cable which shall be pinned to the bracket at one end and which shall provide a turnbuckle style tightening adjustment on the other. The brackets shall incorporate wiring channels so that after installation, all signal cables shall be protected from the effects of exposure to the weather.

**3.2.6.2. SIDE-OF-POLE BRACKETS.** Side-of-pole signal mounting brackets shall be molded of yellow polycarbonate and shall incorporate a mounting arm and pole plate into a single member which shall include guides to correctly position the banding material on the pole plate. The dimensions of the mounting brackets shall be as required to provide proper signal head alignment. Each bracket shall have molded serrations to assure a positive lock with the signal head and allow positioning of the traffic signal heads in increments of 5 degrees. The bracket shall be designed to provide a wiring raceway for signal cable exiting the support pole and entering the signal head.

### 3.2.7. BACKPLATES.

**3.2.7.1.** Backplates shall be of sufficient size to provide a minimum of 5 inches of dark background for the signal indications. They shall be fabricated from a minimum of 0.12 inch black ultraviolet stabilized ABS plastic. They shall have a haircell finish on front and smooth finish on the back. They shall be one-piece construction capable of withstanding a 100 miles per hour wind. Backplates shall be furnished with all necessary hardware to attach to the signal heads.

### 3.2.8. PEDESTRIAN PUSHBUTTON.

**3.2.8.1. PUSHBUTTON.** The pedestrian push button assembly shall be an accessible pedestrian system and consist of an aluminum housing fitted with an easily accessible 2 inch ADA push button. Cover screws shall be stainless steel and the cover shall contain a silicon or neoprene cover to body gasket. The switch and actuator shall be protected from dust and moisture with a silicon or neoprene cover.

### 3.2.9. PEDESTRIAN SIGN.

**3.2.9.1.** The pedestrian information signs shall bear the legend as detailed in the Plans. The sign blank shall be constructed of minimum 0.100 inch thick aluminum alloy. The sign face shall have a non-reflective black legend direct screened on white regular performance sign sheeting. The sign shall be visually accepted by the Engineer.

### 3.2.10. STEEL TRAFFIC SIGNAL POLES.

**3.2.10.1. TAPERED TUBULAR SHAFTS.** Steel traffic signal pole and mast arm shafts shall conform to Section 1608 of the Standard Specifications and the requirements in the Plans. Pole and mast arm shafts shall be tapered tubular members made only of one length of structural steel sheet of not less than No. 7 Manufacturing Standard Gauge (Exception: Signal arms designed for lengths of 38 feet or greater may have arm extensions, of not less than No. 11 gauge steel, with bolted telescopic field joints so as to develop full strength of the adjacent shaft sections to resist bending action).

**3.2.10.1.1. ROUND TAPERED TUBULAR SHAFTS.** Round members shall meet the requirements of the latest edition of ASTM A595 Grade A or B.

**3.2.10.1.2. MULTI-SIDED TAPERED TUBULAR SHAFTS.** Pole and mast arm shafts shall conform to the requirements of ASTM A1011SS Grade 55 or A572 Grade 55 and shall have a minimum 12 sides.

**3.2.10.1.3. WELDING.** Except with written permission from the Engineer, pole and mast arm shaft members shall be made from one length of tubing, or structural steel sheet or plate with no intermediate circumferential welds. Only the single longitudinal seam weld used in the manufacture of the member will be permitted.

**3.2.10.1.4. NON-DESTRUCTIVE TESTING (NDT).** NDT shall be conducted in accordance with Section 744 of the Standard Specifications and the AASHTO 2013 Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, including Interims.

**3.2.10.2. POLES.** The poles shall include a mast-arm-to-pole connection employing a fillet-welded gusseted box or a ring-stiffened box; a reinforced hand hole with gasket cover located near the bottom of the pole and oriented 180 degrees from the mast arm; a grounding lug in the handhole or inside the pole near the handhole; a J or C hook wire support inside the pole near the top of the pole; 4 nut covers; and a removable pole cap that meet AASHTO 2013 Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, including Interims. The poles shall be pre-drilled for the mast arm attachments prior to galvanizing. Rubber grommets shall be furnished for all wire entrances into the pole.

**3.2.10.3. COMBINATION POLES.** When combination lighting and signal poles are specified in the Plans, the poles shall also have suitable clamps for attaching the luminaire arm to the pole shaft. The pole shaft shall be pre-drilled for the luminaire arm attachment prior to galvanizing, with the luminaire arm to be mounted in the same vertical plane as the signal arm. In addition, a reinforced nominal 3 inch by 5 inch hand hole shall be located 180 degrees from and just above the mast arm, and a J or C hook wire support shall be welded inside the pole just above the mast arm.

**3.2.10.4. MAST ARMS.** All signal mast arms shall have suitable brackets attaching to the pole shaft, and a removable end cap. Rubber grommets shall be furnished for all wire entrances into the mast arm.

**3.2.10.5. LUMINAIRE ARMS.** Luminaire arms shall be either single tube or truss-type arms as indicated in the plans. All luminaire arms shall have suitable clamp-on attachment devices for attachment to the pole shaft. Single tube arms shall be welded to one half of the luminaire arm clamp. Truss-type arms shall be furnished with two clamp-on simplex fittings as detailed in the plans.

**3.2.10.6. GALVANIZING.** The poles, mast arms, luminaire arms and all steel accessories shall be galvanized to the requirements of the latest edition of ASTM A123.

**3.2.10.7. DESIGN LOAD.** All traffic signal poles shall be designed to accommodate the standard signal head, signing, and luminaire arm loadings established by the Bureau of Transportation Safety and Technology. The design shall conform to the AASHTO 2013 Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, include Interim's with a wind load of 90 miles per hour and a minimum of 1.14 gust effect factor. The poles shall also accommodate wind loadings which may cause deflections of the mast arm in the vertical plane. These deflections shall never result in less than a 15 foot clearance between the roadway and the lowest point of the signal assembly.

**3.2.10.8. ANCHOR BOLTS.** Anchor bolts shall adhere to Section 1615 (Grade 55) of the Standard Specifications with the exception that cut threads are not permitted. Welding shall conform to the Standard Specifications for State Road and Bridge Construction and the latest edition of the American Welding Society. The leveling nuts may be either Heavy Square or Heavy Hex nuts. Anchor bolt washers conforming to the requirements of the latest edition of ASTM F436 will also be acceptable.

### 3.2.10.9. BASIS OF ACCEPTANCE.

**3.2.10.9.1 STANDARD SHOP DRAWINGS.** All traffic signal poles shall be detailed by the manufacturer on shop drawings. Shop drawings shall reference the actual pole material to be used in the fabrication of poles for a specific Kansas Department of Transportation project. Shop drawings shall include weld details, referencing approved weld procedures. Weld procedures shall be approved by KDOT prior to use. All welding shall be in accordance with Section 744 of the Standard Specifications and the AASHTO 2013 Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, including Interims.

**3.2.10.9.2. POLES AND MAST ARMS.** See Section 1608 of the Standard Specifications for the basis of acceptance for material furnished under that section.

**3.2.10.9.3. ANCHOR BOLTS.** See Section 1615 of the Standard Specifications for the basis of acceptance of anchor bolts for traffic signal poles. If Type "B" certification is not provided according to Section 2601 of the Standard Specifications, the Engineer may require testing of an anchor bolt.

**3.2.10.9.4. TRAFFIC SIGNAL MATERIALS LIST.** Along with the Traffic Signal Materials List, the Contractor shall submit the necessary traffic signal pole ordering information. The Engineer will review the information of compliance with the plan dimensions for pole height, mast arm length and mounting height, and luminaire arm length and mounting height.

**3.2.11. TRAFFIC SIGNAL PEDESTALS.** Traffic signal pedestals shall consist of an aluminum shaft of the length specified in the Plans, a cast aluminum base, anchor bolts with nuts and washers, and be provided with a pole cap.

3	09/21/15	chg's to weld and pole spec	CPA	BDG
2	6/18/14	Updated NDT and shop drawing spec	CPA	BDG
1	06/18/14	Added video and radar detection	CPA	BDG
NO.	DATE	REVISIONS	BY	APP'D

### KANSAS DEPARTMENT OF TRANSPORTATION

### TRAFFIC SIGNAL SPECIFICATIONS

<del>TE120C</del>				
FHWA APPROVAL	12/31/2015	APP'D	Brian D. Gower	
DESIGNED	J.F.F. DETAILED	C.P.A.	QUANTITIES	TRACED
DESIGN CK.	B.D.G. DETAIL CK.	B.D.G.	QUAN. CK.	TRACE CK.