

STATE	PROJECT NO.	YEAR	SHEET NO.	TOTAL SHEETS
KANSAS	87 N-0673-01	2017	90	99

2.18.4. SAW-CUT LOOPS. Saw-cut loops shall be installed in saw cuts as detailed in the Plans. The location of each loop shall be marked on the pavement with crayon or spray paint and approved by the Engineer prior to loop installation. The Contractor shall drill 2-inch diameter holes centered on each point of intersection of the loop slots prior to cutting the slots. The slots shall be cut using a saw equipped with a depth gauge and horizontal guide to obtain proper depth and alignment of the slot. The blade used for the saw cut shall provide a clean, straight, well-defined saw cut of the width and depth indicated in the Plans without damage to adjacent areas. Where the loop changes direction, the saw cuts shall be overlapped to provide full depth at all points of intersection.

2.18.4.1. Before installing the loop wire, the slots shall be checked for the presence of jagged edges or protrusions. Should these exist, they must be removed. The slots must be cleaned and dried to remove cutting dust, grit, oil, moisture or other contaminants. Cleaning shall be achieved by flushing the slot with a high pressure water jet stream. The slot shall then be cleared of water and dried using oil-free compressed air.

2.18.4.2. Loop wire shall be installed in the slot using a dull edge wooden paddle or wheel to prevent damage to the loop jacket. Conductors of each loop shall be run continuously from the nearest pull box with no splices permitted. All loops shall be wound in the same direction with the start and end of each clearly marked with a permanent label at the pull box. The loop conductors running from the loop to the adjacent pull box shall be twisted a minimum of 3 turns per foot. In addition, each loop conductor shall be permanently identified by the loop number shown in the Plans. Paired loops shall be joined in the pull box in series or parallel so that optimum sensitivity as recommended by the detector manufacturer is obtained at the sensor unit.

2.18.4.3. After the conductors are installed in the slots, the loops shall be tested for continuity and shorts with a mega-ohm-meter set at 500 Volts. Any defective wire shall be replaced. After testing, the slots shall be filled with an approved loop sealant to within 1/8 inch of the pavement surface. Before setting, surplus sealant shall be removed from the adjacent road surfaces without the use of solvents.

2.18.4.4. The Contractor may, at his own expense, use approved pre-formed loops instead of saw cut loops.

2.18.4.5. The loop conductors for each loop shall be spliced in the pull box to a detector lead-in cable in accordance with Section 2.16.1.1 of these specifications. The detector lead-in cable shall run continuously from the pull box to the field terminal in the cabinet with no splices permitted.

2.18.5 VIDEO DETECTION SYSTEM (VDS). Installation of VDS shall be per Section 814 of the Standard Specifications and as noted below. The Bid Item shall be "Video Detection System" bid as a Lump Sum. Include items on the materials list for all quantities which are indicated in the Bill of Materials. Install the VDS according to the manufacturer's requirements and the contract documents. The actual quantity of equipment to be furnished is to be installed and made fully functional, as a complete VDS, by the Contractor at the location shown in the Plans. Provide the Engineer with the manufacturer's written requirements.

2.18.5.1 INSTALLATION AND TRAINING (VDS). A factory certified representative from the supplier must be on-site during installation, testing and training of the video and computer equipment. Two days of training shall be provided for the owner's personnel in the operation of the VDS including setup and maintenance. Ensure that the trainers are certified by the equipment manufacturer and meet the certification requirement in Section 2.3 of the Standard Specification. Camera fine tuning and system set-up and programming shall be performed by the supplier with assistance of the contractor. Two complete manuals shall be provided to the owner.

2.18.5.2 DETECTION ZONE (VDS). The video detection system must provide flexible and reliable detection zone placement anywhere within the combined field of view of the image sensors. Preferred presence detector configurations are lines or boxes placed across lanes of traffic or lines placed in-line with lanes of traffic. In addition, detection zones must be capable of implementing logical functions including delay timing. These logical functions may be excluded if provisions are made to bring each detector separately into the controller and the controller can provide these functions. Place the detection zones by means of graphical interface using the video image of the roadway. The detection zones must be capable of being sized, shaped and overlapped to provide optimal road coverage and to retrieve the detector configuration that is currently running in the VDS processor unit. Once a detection configuration is created, the system must provide a graphic display of the new configuration on the field monitor. Detection accuracy must include the presence of any vehicle in the defined detection zone regardless of the lane that the vehicle is occupying.

2.18.6 RADAR DETECTION SYSTEM (RDS). Radar detection is an option for advanced and/or presence detection if approved by the design engineer. Installation of radar detection shall be per Section 814 of the Standard Specifications and as noted below. The Bid Item shall be "Radar Detection System" bid as a Lump Sum. Include items on the materials list for all quantities which are indicated in the Bill of Materials. The RDS shall be installed according to the manufacturer's written requirements with the actual quantity of equipment to be furnished, installed and made fully functional, by the Contractor at the location shown in the Plans. Provide the Engineer with the manufacturer's written requirements.

2.18.6.1 INSTALLATION AND TRAINING (RDS). A factory certified representative from the supplier must meet the same specification as Section 2.18.5.1 for radar as well as video installation and training. Trainers are to be certified and meet the requirement in Section 2.3 of the Standard Specification.

2.18.6.2 DETECTION ZONE (RDS). The radar presence detection zone must meet as a minimum Section 2.18.5.2. Advance radar detection shall provide the necessary adjustments to detect approaching vehicles on high speed facilities. All radar detection shall include the necessary hardware and software required to communicate with the controller according to these standard specifications and the Plans.

2.19. SIGNS.

2.19.1. OVERHEAD STREET NAME SIGNS. Street name signs shall be installed on mast arms after all other loads are applied to the mast arm. The signs shall be located in accordance with the plan details. Signs shall be mounted so that the legend is level. The final location shall be determined by the Engineer.

2.19.1.1. INSTALLATION. Installation of signs on mast arms shall be accomplished with suitable stainless steel banding, clamps, and brackets capable of withstanding 100 miles per hour winds. Street name signs over 18 inches in height shall be installed using approved sign mounting brackets as shown in the Plans. All bolts inserted through sign faces shall have flat fiber washers installed between the reflective sheeting and bolt heads. Bolt holes in signs shall be drilled in the field.

2.19.2. REGULATORY SIGNS. The R10-Series signs shall be mounted on the mast arm to the right of the left turn signal head using an approved sign mounting bracket as shown in the traffic signal installation details.

2.19.3. PEDESTRIAN PUSHBUTTON SIGNS. Pedestrian pushbutton signs shall be mounted to the traffic signal pole above the appropriate pedestrian pushbutton. Mounting shall be accomplished using suitable stainless steel banding, clamps and brackets capable of withstanding 100 mile per hour winds. As an alternative, the pedestrian sign mounting bracket may be constructed integral to the pedestrian pushbutton assembly.

2.20. PEDESTRIAN PUSHBUTTONS. Pedestrian pushbuttons shall be installed on the poles or pedestals as indicated in the Plans. They shall be installed at a height of 3 feet 6 inches above the sidewalk (or ground if no sidewalk is present). The pushbutton shall be located on the side of pole nearest the pedestrian walkway, and perpendicular to the intended crossing direction.

2.20.1 ACCESSIBLE PEDESTRIAN SIGNAL (APS). If two accessible pedestrian pushbuttons are placed less than 10 feet apart or on the same pole, each accessible pedestrian pushbutton shall be provided with the following features (2009 MUTCD Section 4E.11 through 4E.13).

- A. A pushbutton locator tone,
- B. A tactile arrow,
- C. A speech walk message for the WALKING PERSON (symbolizing WALK) indication, and
- D. A speech pushbutton information message.

If 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 signal are on one corner are not separated by a distance of at least 10 feet, the audible walk indication shall be a speech walk message.

2.21. TRAFFIC SIGNAL TURN-ON.

2.21.1. FLASHING OPERATION At locations without previous traffic signal control, the new traffic signals shall be flashed 2 to 3 business days prior to full signal system turn-on.

2.21.2. SYSTEM TURN-ON. The signal system turn-on shall not occur on Fridays, weekends, or holidays and shall be completed prior to 3:00 p.m. on the day of the turn-on.

2.21.3. SUPPLIER REPRESENTATIVE. The supplier of control equipment shall have a representative present at the signal system turn-on.

2.21.4. TRAFFIC ENGINEERING NOTIFICATION. The Bureau of Transportation Safety and Technology shall be notified at least one week in advance of the date of signal turn-on.

2.22. TEST PERIOD. Following completion of all electrical apparatus hook-ups and the system turn-on, the signals shall operate satisfactorily for 30 days under normal operation prior to acceptance by the State. During the test period, the signals shall operate trouble-free with no major failures of the controller or its components. Should any defect develop under normal and proper operating conditions during the testing period and prior to acceptance by the State, this malfunction shall be corrected by and at the expense of the Contractor, including all labor, materials and associated costs. Minor failures such as lamp failures or loop detector re-turning will not be the basis for starting a new test period, provided the failures are repaired immediately and the same failures do not recur during the remainder of the test period. A major malfunction or failure of the controller and its components will result in a new 30 day test period being implemented after the repairs have been made.

2.23. GUARANTEE. All equipment furnished on a project by the Contractor shall be guaranteed against any imperfections in workmanship and materials. The customary manufacturers' warranties shall be assigned to the Maintaining Agency.

2.24. MANUALS. A minimum of 2 manuals shall be provided for each controller and shall include complete nomenclature, wiring diagrams, schematics showing test voltages, functional description of circuits, parts list and cross reference to standard part numbers, appropriate testing procedures, and other pertinent data.

3. MATERIALS.

3.1. DESCRIPTION. These specifications cover the general materials and miscellaneous hardware for the installation of a traffic signal to be constructed in accordance with and at locations indicated in the contract, shown in the Plans or designated by the Engineer.

3.2. MATERIAL REQUIREMENTS.

3.2.1. GENERAL. All materials used in the fabrication or assembly of the items listed below shall be new, shall be of the best quality and workmanship,

3.2.1. GENERAL (CONTINUED).

shall be the best standard product of a manufacturer regularly engaged in the production of this type of equipment and shall be of the manufacturer's latest approved design. Major items of electronic equipment installed under this contract shall be of the same type and consist of products supplied by the same supplier in order to secure uniformity, single responsibility, and most satisfactory service.

3.2.1.1. The traffic signal shall be complete, and the Contractor shall furnish and install all equipment necessary for the satisfactory operation of the signal system whether specifically mentioned or not.

3.2.2. NEMA TRAFFIC CONTROLLER ASSEMBLY.

3.2.2.1. GENERAL. The NEMA Traffic Controller Assembly shall meet the requirements of the NEMA Standards Publication No. TS 2-2003. The NEMA traffic controller assembly shall be either pole mounted or pad mounted. The specific requirements of each type are listed below.

3.2.2.2. CONTROLLER UNIT. The controller unit shall meet the requirements of a Type 1 or Type 2 per Section 3.2 of the NEMA Standards. The TS2-Type 1 controller is not backward compatible however the TS2-Type 2 is backward compatible. When using a hybrid controller the back panel configuration in Section 3.2.2.2.1 shall be used.

3.2.2.2.1 BACK PANELS. Back panels (load switch bays) shall meet TS1 specifications for all controller assemblies. This is to facilitate easy accommodations of blank out signs and overlap wiring practices that might be required by the local agencies. NEMA Type 4(G) cabinets will have an 8 position load switch bay with vehicle phases 1, 2, 3, & 4; pedestrian phases 2 & 4, and overlaps A & B. NEMA Type 6 and 7 cabinets will have a 16 position load switch bay with vehicle phases 1 thru 8, pedestrian phases 2, 4, 6, & 8, and overlaps A, B, C, & D. 16 position load switch bays shall be prewired for the Flashing Yellow Arrow (FYA) application.

3.2.2.3. MALFUNCTION MANAGEMENT UNIT. The malfunction management unit shall meet the requirements of Section 4 of the NEMA Standards.

3.2.2.4. TERMINALS AND FACILITIES. The controller assemblies' terminals and facilities shall, as a minimum, meet the requirements of Section 5 of the NEMA Standards.

3.2.2.4.1. POLE MOUNTED CONTROLLER ASSEMBLIES. The pole mounted controller assemblies shall, as a minimum, be equipped with wired sockets and bus interface units of the quantities listed for Configuration 2 of Table 5-2 of the NEMA Standards.

3.2.2.4.2. PAD MOUNTED CONTROLLER ASSEMBLIES. The pad mounted controller assemblies shall be classified as either size 5 (M) or size 6 (P). Size 5 pad mounted controller assemblies shall be equipped the same as pole mounted controller assemblies. Size 6 pad mounted controller assemblies shall, as a minimum, be equipped with wired sockets and bus interface units of the quantities listed for Configuration 4 of Table 5-2 of the NEMA Standards. If the Plans require more than 16 channels of detection, then additional detector racks of Type 2 configuration shall be added to provide the necessary detector slots.

3.2.2.4.3. AC SERVICE TRANSIENT SUPPRESSION. The transient protection device for primary feed of the cabinet shall be connected on the load side of the cabinet overcurrent protection device and shall meet Section 5.4.2.4 of the NEMA standards, except that it shall have a clamp voltage of 250 Volts and be designed to absorb power line noises in the range of 10 kilohertz to 20 megahertz.

3.2.2.4.4. LIGHTING FIXTURE. Cabinets shall be furnished with Fluorescent or LED light fixtures, including lamps or LED's, over the front and back doors that are controlled by door-activated switches.

3.2.2.4.5. LIGHTING FIXTURE SWITCH. The light switch shall be door actuated.

3.2.2.4.6. POLICE COMPARTMENT SWITCHES. The panel behind the police door shall contain 2 switches to accomplish the following functions: (1) change from normal operation to flashing, and vice versa, and (2) interrupt power to the signal heads.

3.2.2.4.7 CABINET POWER SUPPLY. The cabinet power supply shall provide regulated DC power, unregulated AC power, and a line frequency reference for the Detector rack, for all Bus-Interface units, Load Switches, detectors for a TS-2 Type 1 and other auxiliary equipment. The Type 2 controller interface provides 500mA of +24 VDC power. As such, the use of cabinet power supply is optional when using a Type 2 controller.

3.2.2.5. AUXILIARY DEVICES. The auxiliary plug-in devices shall, as a minimum, meet the requirements of Section 6 of the NEMA Standards.

3.2.2.5.1. THREE-CIRCUIT SOLID STATE LOAD SWITCHES. The load switches shall meet the requirements of Section 6.2 of the NEMA Standards.

3.2.2.5.2. SOLID STATE FLASHERS. The flashers shall meet the requirements of Section 6.3 of the NEMA Standards.

3.2.2.5.3. FLASH TRANSFER RELAYS. The flash transfer relays shall meet the requirements of Section 6.4 of the NEMA Standards.

3.2.2.6. CABINETS. The cabinets shall meet the requirements of Section 7 of the NEMA Standards, as modified below.

3.2.2.6.1. HOUSING. The cabinets shall be of unpainted sheet aluminum alloy construction.

3.2.2.6.2. POLE MOUNTED CONTROLLER ASSEMBLIES. The pole mounted controller cabinet shall be size 4 and meet the requirements of Section 7.8.1 of the NEMA Standards. The cabinet shall have a continuously welded bottom of the same material as the rest of the cabinet.

3.2.2.6.3. PAD MOUNTED CONTROLLER ASSEMBLIES. Size 5(M) pad mounted controller assembly cabinets shall be size 5 per Table 7.8.3.1 of the NEMA Standards. Size 6(P) pad mounted controller assembly cabinets shall be size 6 per Section 7.8.3.2 of the NEMA Standards.

3.2.2.7. BUS INTERFACE UNIT. The bus interface units shall meet the requirements of Section 8 of the NEMA Standards.

3.2.3. TYPE 170E/2070 TRAFFIC SIGNAL CONTROL SYSTEM.

3.2.3.1. GENERAL. The 170E/2070 Type traffic signal control systems shall, as a minimum, meet the Caltrans Transportation Electrical Equipment Specifications (TEES), dated March 12, 2009.

3.2.3.2. RESPONSIBLE PARTIES. Any reference to the State, State of California, or Agency shall mean the local agency responsible for maintaining the traffic signal. Any reference to the Contractor shall mean equipment manufacturer or supplier.

3.2.3.3. TESTING MANUALS. Two manuals containing the flow chart, listing, and instructions of the test program shall be furnished to the agency responsible for maintaining the traffic signal when the controller unit is delivered.

3.2.3.4. CABINETS. The cabinets shall be Model 332 series and 336 series meeting the requirements of Chapter 6 of the TEES with the following modifications.

3.2.3.4.1. FINISH. The cabinet finish shall be natural aluminum.

3.2.3.4.2. LIFT EYES. The cabinet lift eyes shall be removable so that they can be turned down after installation of the cabinet.

3.2.3.4.3. LIGHT FIXTURES. Cabinets shall be furnished with Fluorescent or LED light fixtures, including lamps or LED's, over the front and back doors that are controlled by door-activated switches.

3.2.3.4.4. PLAN DRAWER/WORK SURFACE. A drawer shall be mounted in the EIA rack between the Controller and the top input file. It shall be mounted on sliding tracks having lockout and quick-disconnect features. The drawer shall be able to extend out 14 inches, and shall be capable of supporting a 40 lb. load when fully extended. The drawer shall be provided with a hinged aluminum top covered with a chemical-proof Formica-type plastic sheet that can be lifted to gain access to the interior of the drawer. The interior of the drawer shall have nominal dimensions of 1 inch high, 13 inches deep, and 16 inches wide.

3.2.3.4.5. ADDITIONAL MODEL 336 REQUIREMENTS. The Model 336 cabinets shall be furnished with a continuously welded bottom of the same material as the rest of the cabinet, and all of the hardware necessary to permit mounting to a 12 inch outside diameter pole.

3.2.3.4.6. ADDITIONAL MODEL 332 REQUIREMENTS. The Model 332 cabinets shall be furnished with the power distribution assembly #2 in lieu of the power supply and power distribution #1 assemblies. The cabinets shall be supplied with the circuit breaker option per Chapter 6 Section 4 of the TEES. The cabinet shall be furnished with anchor bolts, nuts and washers.

3.2.3.4.7. ADDITIONAL OUTPUT FILE #1 REQUIREMENTS. The output file #1 supplied with the cabinet shall be modified to provide compatibility with the red monitoring features of the conflict monitor.

3.2.3.5. CONTROLLER. The controller unit shall be a Model 170E/2070 per Chapter 2 of the TEES, dated March 12, 2009.

3.2.3.6. PROGRAM MODULE. The program module shall be a standard Model 412C as specified in Chapter 3, Section 6 of the TEES, dated March 12, 2009. The program module shall be provided with the latest version of the Wapiti Micro Systems W41KS software.

3.2.3.7. CONFLICT MONITOR. The conflict monitor shall meet the requirements of a Model 210 per Chapter 3, Section 6 of the TEES with the following additional monitoring functions: red monitoring; absence of signal on a channel; simultaneous multiple indications on a channel; program card ajar; power interrupt after failure; short or absence of yellow; AC line monitoring; full systems compatibility with Wapiti Microsystems Traffic Systems software.

3.2.3.8. FLASHER. The flasher shall meet the requirements of a Model 204 flasher per Chapter 3 Section 3 of the TEES.

3.2.3.9. LOAD SWITCH. The load switch shall have modular switches that can be easily replaced with the use of a screwdriver, and meet the requirements of a Model 200 switch pack per Chapter 3 Section 2 of the TEES.

3.2.3.10. FLASH TRANSFER RELAYS. The flash transfer relays shall be heavy duty relays meeting the requirements of the Model 430 per Chapter 6 Section 4 (6.4.6) of the TEES.

3	07/02/15	Updates to format & controller designation	CPA	BDG
2	06/07/14	Added Video and Radar Detection	CPA	BDG
1	06/07/14	Updates to format and language	CPA	BDG
NO.	DATE	REVISIONS	BY	APP'D

KANSAS DEPARTMENT OF TRANSPORTATION

TRAFFIC SIGNAL SPECIFICATIONS

TEI20B

FHWA APPROVAL	12/31/2015	APP'D	Brian D. Gower, P.E.
DESIGNED	C.P.A.	DETAILED	C.P.A.
DESIGN CK.	B.D.G.	DETAIL CK.	B.D.G.
		QUANTITIES	TRACED
		QUAN. CK.	TRACE CK.

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