

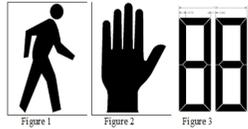
INSPECTION POINTS FOR TRAFFIC SIGNAL WORK BEING DONE IN WYANDOTTE COUNTY KANSAS

The following list refers to points during the construction process that will require an on-site inspection or observation before proceeding further with the construction project. The inspection will be completed by a member of the Traffic Signal Department of the Board of Public Utilities. The contractor is required to notify the Traffic Signal Department when they are performing any of the following tasks so they can inspect the process and make any necessary approvals or changes at 913-645-1449 or 913-573-9450.

1. Inspect the materials purchased and being utilized for the construction before starting the project.
2. Inspect the staked positions for the cabinets, pull boxes, and all poles.
3. Observe the boring process to make sure all splices are done properly and with the proper type of conduit or HDPE.
4. Observe the setting of pull boxes and make sure the conduit is piped into them correctly.
5. Inspect all concrete foundations for proper rebar and bolt configurations before concrete is poured.
6. Inspect the job site upon completion for any clean up or grading concerns.
7. Inspect forms before pouring concrete to ensure proper placement of conduit, the number of conduit being installed, and the size of conduits being installed.

		TRAFFIC SIGNAL SPECIFICATIONS	
		SHEET 1 OF 9	
		CITY OF KANSAS CITY, KANSAS PUBLIC WORKS DEPARTMENT TRAFFIC DIVISION	
			DESIGNED: KCK
			DRAWN: B&McD
			DATE: 3/20/2017
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All LED equipment should be suggested to field inspection of equipment, installation and acceptance by a BPU traffic signal technician. Light Emitting Diode (LED) equipment for traffic signal should meet minimum standards for material, physical and mechanical characteristics, environmental requirements and constructions as described by the most recent Vehicle Traffic Control Signal Heads (VTCSH), LED for Circular Traffic Signal and LED for Arrow Traffic Signal and the Pedestrian Traffic Control Signal Indications (PTCSI) published by the Institute of Transportation Engineers (ITE) and corresponding Manual of Uniform Control Devices (MUTCD).



Dimensions for Figures 1, 2 and 3

For each nominal message bearing surface (module) size, use the corresponding minimum H (height) and W (width) measurements:

Module Size	Icon Height	Icon Width	Countdown Height	Countdown Width	Countdown Segment Width
(16 x 18 in)	11 in	7 in	9 in	7 in	0.7 in

Note: The units shall not have any accessible dip switches, toggle switches or options available that will allow the mode to be changed from counting the clearance cycle, to the full walk/don't walk cycle or any other modification to the icons or digits.

LED Pedestrian Countdown Timer Environmental Requirements

- All exposed components of a module shall be suitable for prolonged exposure to the environment, without appreciable degradation that would interfere with function or appearance. As a minimum, selected materials shall be rated for service for a period of a minimum of 60 months in a south-facing Arizona Desert installation.
- A module shall be protected against dust and moisture intrusion, including rain and blowing rain. Shall be sealed and meet MIL-STD-810F Procedure I, Rain & Blowing Rain specifications.
- The module lens shall not crack, craze or yellow due to solar UV irradiation typical for a south-facing Arizona Desert installation after a minimum of 60 months in service.
- To prevent water seepage between the back cover and the electrical wires, or between the copper and insulation of the wires, the electrical wires shall not penetrate the LED pedmodule housing. Connection shall be made by use of an over-molded connector.
- The ped module shall be a single, self-contained device, not requiring on-site assembly for installation into an existing pedestrian signal housing. The power supply shall be designed to fit and mount inside the pedestrian signal module.
- The assembly and manufacturing process for the module shall be designed to assure all internal LED and electronic components are adequately supported to withstand mechanical shock and vibration from high winds and other sources.

LED Pedestrian Countdown Timer Module Identification

- Each pedmodule shall be identified on the backside with the manufacturer's name, model, serial number and operating characteristics of each symbol. The operating characteristics identified shall include the nominal operating voltage and stabilized power consumption, in watts and Volt-Amperes.
- Modules conforming to this specification (WALKING PERSON, UPRaised HAND only) may have the following statement on an attached label: "Manufactured in Conformance with the ITE Pedestrian Traffic Control Signal Indications - Part 2: Light Emitting Diode (LED) Pedestrian Signal Modules".

LED Pedestrian Countdown Module Functions

Cycle:

The module shall operate in one mode: Clearance Cycle Countdown Mode Only. The module shall start counting when the flashing don't walk turns on and will countdown to "0" and turn off when the steady "Don't Walk" signal turns on. The module shall not have user accessible switches or controls for the purpose of modifying the cycle, icons or digits.

Learning Cycle:

At power on, the module enters a single automatic learning cycle. During the automatic learning cycle, the countdown display shall remain dark.

Cycle Modification:

The unit shall re-program itself if it detects any increase or decrease of Pedestrian Timing. The digits shall go blank once a change is detected and then take one complete pedestrian cycle (with no counter during this cycle) to adjust its buffer timer.

Recycling:

The module shall allow for consecutive cycles without displaying the steady Hand icon ("Don't Walk").

Pre-Emption:

The module shall recognize preemption events and temporarily modify the crossing cycle accordingly.

- If the controller preempts during the walking man, the countdown shall follow the controller's directions and shall adjust from walking man to flashing hand. It shall start to count down during the flashing hand.
- If the controller preempts during the flashing hand, the countdown shall continue to count down without interruption.

The next cycle, following the preemption event, shall use the correct, initially programmed values. This specification is worded such that the flashing don't walk time is not modified.

"Don't Walk" Steady:

If the controller output displays Don't Walk steady condition or if both the hand/person go dark and the unit has not arrived to zero, the unit suspends any timing and the digits shall go dark.

Power Outage:

The digits will go dark for one pedestrian cycle after loss of power of more than 2.0 seconds.

Digit Operation:

The digits shall remain continuously lit during the clearance cycle and shall not flash in conjunction with the Hand/Don't Walk icon.

2.7 MOUNTING HARDWARE:

2.7.1 Side mounted vertical bracket: Side vertical bracket mounted signal heads, as shown on the Standard Drawings, shall be supported by a one piece mounting bracket watertight assembly made entirely of a durable polycarbonate and be yellow in color. Each bracket shall either be plumb or level, symmetrically arranged and securely assembled. Each bracket shall have 72 tooth serrations to assure a positive lock with a signal head and allow positioning traffic signal heads in increments of 5 degrees. Construction shall be such that conductors are concealed within the assembly. Brackets shall be attached to the pole or the pedestal by stainless steel banding and brackets.

2.7.2 Mast arm Mounting Assemblies: Mast arm signal head assemblies shall be rigid mounted utilizing a universally adjustable bracket consisting of both top and bottom brackets with a center vertical extruded aluminum support tube attached to the mast arms by means of a clamp kit with stainless steel banding. The top and bottom brackets shall have 72 tooth serrations cast into the arm to assure a positive lock with the single housing. The vertical support tube should allow wire entry at any point and be equipped with a vinyl insert that conceals the wiring. The lower bracket arm shall be hollow for wiring entry into the single head.

2.8 SIGNAL BACKPLATES: 5-inch backplates shall be furnished and attached to the single faces to provide a dark background for the signal indications. Backplates shall be constructed of one-piece durable black plastic capable of withstanding a 100-mile per hour wind. Backplates shall be attached to the signal as per the manufacturer's recommended practice.

2.9 ADVANCED ACCESSIBLE PEDESTRIAN SYSTEM: The Advanced Accessible Pedestrian System is required. This system shall be a web based system that is capable of managing 16 push buttons from a single control module. The push buttons shall be vibra-tactile with a raised profile arrow that points in the direction pedestrians are to travel. The push button housing shall also include the capability of mounting a 9 inch * 15 inch pedestrian sign that includes countdown timer legend (R10-3e) and has perforations over the speaker.

2.10 MULTI-CONDUCTOR SIGNAL CABLE: Multi-conductor signal cable shall conform to Section 19-1 of the latest edition of the International Municipal Signal Association, Inc. (IMSA) requirements, except all conductors supplied shall be standard copper with a size of 14 gauge. The cable shall be for operation on a 600-volt maximum and suitable use for conductor temperatures not exceeding 75 degrees Celsius. The number of conductors per cable shall be as shown on the plans.

2.11 COPPER INTERCONNECT CABLE: When copper wire is specified on the plans for interconnect cable, it shall be premium cable type phone grade interconnect cable. The cable shall be #19 A.W.G., solid copper cable having an 0.008-inch aluminum shield and shall be gel-filled for aerial and duct use. In addition, the cable shall meet the following requirements:

- Conductor: Solid, annealed copper
- Conductor Insulation: High density polyethylene or polypropylene
- Core Covering: Non-hygroscopic dielectric tape
- Shield: Copolymer-coated corrugated aluminum 0.2 mm (0.008")
- Jacket: Virgin, black, high-molecular weight Polyethylene with surface marked measure

The cable be for operation on a 600 volt maximum and shall be filled with non-hygroscopic filled compound for moisture resistance in all applications.

2.12 OPTICAL FIBER INTERCONNECT CABLE: When optical fiber cable is specified on the plans for traffic signal interconnection or communication, the optical fiber interconnect cable along with connectors will be defined in Special Provisions for each specific project or as defined by the City Traffic Engineer.

2.13 DETECTOR LOOP WIRE: The detector loop wire shall be #14 A.W.G. stranded copper, type THHN, 1-conductor cable with PVC/nylon insulation housed in PVC tubing meeting IMSA Specifications 51-3. The PVC tubing shall be ULFR-1 rated 105 degrees C with a 0.031" wall thickness plus or minus 0.003" and 0.182" minimum to 0.198" maximum inside diameter.

2.14 LOOP WIRE SEALANT: Sealant for loop detectors shall be (3M Detector Loop Sealant. Sealant shall be gray for concrete pavement and black for asphaltic pavement. Sealant shall be prepared and installed in accordance with manufacture's instructions. The contractor shall submit the manufacturer's catalog information and instructions to the City Traffic Engineer for review and approval.

2.15 SPLICE SEAL: Splice seal for loop detectors shall be Tyco Electronics AMP sealing and dielectric compound patches; product #275442-1, Rev F.

2.16 DETECTOR LEAD-IN CABLE: The detector lead-in cable shall be rated for 600 volts and shall be #18 A.W.G. 4-conductor (red, green, black, white) stranded and shielded cable. The conductors shall be tin-coated, annealed copper enclosed in an aluminized shield and a high-density polyethylene jacket. All wires shall be insulated with cross-linked polypropylene or polyethylene and provided with a vinyl jacket. The interstices of the cable are not to be filled with a water blocking material. The outside diameter of the cable shall be 0.25 inches or less and shall be suitable for use in conduit, direct burial, or saw slot installation.

2.17 TRACE WIRE: Trace wire shall be red #14 A.W.G. stranded, Type THHN, 1-conductor cable with PVC/nylon insulation housed in PVC tubing meeting IMSA specification 15-5. The PVC tubing shall be ULFR-1 rated 105 degrees C with a 0.031" wall thickness plus or minus 0.003" and) .182" minimum to 0.198" maximum inside diameter.

2.18 PULL ROPE: Pull rope is for conduit for metallic cable. It shall be 3/8" nylon and capable of pulling the required bundle of electrical cable.

2.19 MULE TAPE: Mule tape is for conduit for optical fiber. Mule tape shall be capable of pulling 72-count optical fiber at the tension rating allowable for optical fiber.

2.20 POWER CABLE: Power lead-in cable shall be of the sizes and numbers of conductors as shown on the plans.

The cable shall be for operation on a 600 volt maximum and suitable for use at conductor temperatures not exceeding 75 degrees Celsius. Material, construction, and tests shall be in accordance with the applicable requirements of the Insulated Power Cable Engineer's Association (IPCEA) Standard S-66-524 "Cross-Linked-Thermosetting-Polyethylene Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy."

Conductors shall be stranded, annealed coated copper. Copper wire, before insulating or stranding, shall meet the requirements of the latest edition of ASTM B-33 (coated wire). Stranding shall be class B, in accordance with the latest edition of ASTM B-8. Insulating shall consist of cross-linked thermosetting polyethylene, meeting the requirements of column B of IPCEA and listed by U.L. as Type USE RHW-75 DEGREES C.

2.21 POWER SERVICE ENCLOSURE: The Power Service Enclosure shall be a lockable 70-amp circuit breaker box, raintight enclosure equipped with a main breaker and a 50-amp traffic signal breaker to be operated at 120 volts AC. The unit shall be capable of receiving either 120/240 volt or 208 volt AC electrical line service. The unit shall be U.L. listed.

Ten-inch secondary extension brackets shall be used to clamp the secondary service conduit to the power pole. The brackets shall be either Joslyn #2357, McGraw Edison #DR2E2, or approved equal.

2.22 GROUNDING: Grounding on traffic signal components shall be accomplished using a #6 A.W.G. solid bare copper wire connected to ground lugs. Ground wire shall be attached by means of a ground clamp to copper-clad steel rods. Ground rods shall be ¾ inches in diameter and 10 feet long. See Section 3.3.6 for additional information on bonding and grounding (Installation of Wiring).

2.23 CONDUIT FOR METALLIC CABLE: Unless otherwise shown on the plans, all conduits shall be Schedule 80 high-density polyethylene (HDPE) duct manufactured to ASTM D2447, ATSM D3035 and NEMA TC7 specifications. The duct shall be pre-lubricated, have smooth walls and shall be marked at regular intervals with the name of the manufacture and duct size. Couplings shall be from the same manufacturer of the duct and shall be air and watertight. HDPE conduit for traffic signal use shall be red.

HDPE conduit for street lighting use shall be gray. Schedule 80 PVC is required between service boxes and concrete foundations including conduit inside foundations. PVC conduit shall be gray.

Conduit used for service runs and service risers shall be metallic, unless otherwise directed by the Board of Public Utilities (BPU) Traffic Signal Department or the City Traffic Engineer.

2.24 CONDUIT FOR OPTICAL FIBER: Conduit for optical fiber shall be HDPE SDR 11. It shall be black with three red stripes and shall be labeled 'KCK / BPU'. Conduit shall be continuous for the length of the bore. Conduit may be fusion spliced for long runs (greater than 700 feet) between service boxes. Compression splices will not be allowed, except on bridges.

2.25 TRAFFIC SIGNAL MAIN SERVICE BOXES: Main service boxes for traffic signal systems shall be polymer-concrete composites, stackable for varying depths, rated for 20,000 lbs. loading, and with heavy duty covers meeting design loads of 22,500 lbs minimum. Boxes shall not have bottoms. All boxes will be 36-inch depth. Adjustment layers may be varying depths as called out on the plans. Nominal size will be 30-inch by 48-inch. Plans may call for a smaller or larger nominal size depending on site conditions. Main service boxes shall have the legend 'TRAFFIC' inscribed on the lids. Lids shall be in two pieces.

2.26 TRAFFIC SIGNAL SERVICE BOXES: Service boxes shall be corrugated steel pipe, #14 gauge, meeting the requirements of AASHTO M-36. All service boxes shall have annular rings (for ease of future adjustment) and shall have either a 24-inch diameter or an 18-inch diameter with a shape as shown on the Traffic Signal Detail sheets in the accompanying plans. The frame and lid for the 24-inch service box shall be either Neenah R5900-E or approved equal and shall have the legend "TRAFFIC" inscribed on the lid. The frame and the lid for the 18-inch service box shall be either Neenah R-5900-C, or approved equal and shall have the legend "TRAFFIC" inscribed in the lid. Frames for lids must be specifically manufactured for corrugated steel pipe and have the capability of being spot welded to the corrugated steel pipe.

2.27 OPTICAL FIBER SERVICE BOXES: Optical fiber service boxes for traffic signal interconnect systems shall be polymer-concrete composites, stackable for varying depths, rated for 20,000 lbs. loading, and with heavy duty covers meeting design loads of 22,500 lbs minimum. Boxes shall not have bottoms. All boxes will be 36-inch depth. Adjustment layers may be varying depths as called out on the plans. Nominal size will be 30-inch by 48-inch. Plans may call for a larger nominal size of 36-inch by 60-inch at locations where underground splice enclosures are required and where large amounts of recoverable slack will be required. These locations will be called out on the plans. Optical fiber service boxes shall have the legends 'UG TRAFFIC' and 'OPTICAL FIBER' inscribed on the lids.

2.28 CONTROLLER CABINET: This specification describes the minimum requirements for a traffic controller cabinet for use with a TS-2, Type II controller unit and incorporating selected features and functionality as defined by NEMA specifications TS-2 (Latest Versions) which are incorporated herein by reference.

All load switching control shall be as defined by NEMA specification TS-2 as modified by this specification. Detection control and signal monitoring shall be as defined by NEMA specification TS-2 as modified by this specification.

The controller and all associated equipment shall be furnished completely housed in a sturdy aluminum cabinet. The cabinet shall and TS-2, Type I Cabinet and be of clean cut design and appearance having no sharp edges, corners or projections. It shall be a minimum "R" size having approximate dimensions of 72" H X 44" W X 25" D. A hinged door shall be provided permitting complete access to the interior of the cabinet. The cabinet is to be weather proof and dust tight. The door shall be provided with a strong lock and two sets of keys. The door hinges and pins shall be of a non-corroding material.

The cabinet shall contain four strong mounting shelves for the support of the controller and associated equipment.

A solid-state two circuit, cube type, jack mounted flasher with a rated load of 10 amps per circuit shall be supplied. Where additional load is required, more than one flasher will be provided. The flasher shall flash at the rate of 50 to 60 flashes per minute and be of the "zero switching" type to prevent radio interference.

The cabinet shall be equipped with two ventilating fans, each capable of circulating air at a rate of 100 cfm, controlled by a thermostat and shall include suitable dust filters for the capacity of the ventilating system. The filters shall be of the dry type and easily replaced. The filter shall be located behind louvers in the lower portion of the main cabinet door. The top of the cabinet shall include an exhaust air plenum with a vent screen having perforations no greater than 0.125 inches in diameter and located so as preclude the entrance of moisture into the cabinet.

		BY		TRAFFIC SIGNAL SPECIFICATIONS	
		REVISIONS		SHEET 3 OF 9	
		DATE		CITY OF KANSAS CITY, KANSAS PUBLIC WORKS DEPARTMENT TRAFFIC DIVISION	
		DESIGNED:		KCK	DRAWN: B&McD
		CHECKED:		B&McD	DATE: 3/20/2017
		SCALE:		N/A	SHEET NO.:

2.29.6 Communications

In addition to NEMA requirements, the controller shall provide the following:

- a) Built-in 10 Base-T Ethernet with RJ-45 connector on controller front panel
- b) Built-in Internet Protocol (IP) address assigned by Institute of Electrical and Electronic Engineers (IEEE), one unique IP address for each controller.
- c) Built-in Infrared (IR) wireless port compatible with Microsoft Windows for Pocket PC Infrared RAW mode.
- d) Built-in 1200 bps Frequency Shift Keying (FSK) modem. Modem is optional per Agency specification. Choice of 2 or 4 wire operation will be defined in the Special Conditions.
- e) Built-in EIA-232 port for uploading and downloading applications software, as well as to update the operating system.
- f) Built-in C60 connector for use with removable Keyboard and Display, Personal Computer COM1 or Personal Digital Assistant (PDA). C60 protocol per Joint NEMA/AASHTO/ITE ATC standard.

2.29.7 Controller Housing

In addition to NEMA requirements, the controller housing shall provide the following:

- a) Seven slots with card guides for standard 3U size Versa Module Europe expansion modules. The expansion modules and mating back plane board in controller are optional, per Agency specification.
- b) Two slots with card guides for standard Joint NEMA/AASHTO/ITE ATC modems. The modems and mating back plane board in the controller are optional, per Agency specification.
- c) Polycarbonate construction, except back panel, rear mounting tabs and power supply mounting plate shall be aluminum for electrical grounding.
- d) Built-in carrying handle
- e) Two adjustable front mounting feet, used to raise the front cables and vary the display viewing-angle.

2.29.8 Traffic Control Software Functions

In addition to NEMA requirements, the controller shall provide the following:

- a) 16 Vehicle Phases
- b) 16 Pedestrian Phases
- c) 4 Timing Rings
- d) 16 Overlaps
- e) 80 Detectors
- f) Status: Ring Timers, Coordination Timers, Preempt Timers, Time Base, Communication, Detector Diagnostics, Intersection, Input / Output
- g) Reports: Local Alarm Log, Communications Fault Log, Detector Fault Log, System Detector Log, MOE Log, Speed Log, Volume Count Log, Cycle MOE Log
- h) Coordination Modes: Permissive Mode, Yield Mode, Permissive Yield Mode, Permissive Omit Mode, Sequential Omit Mode, Full Actuated Mode.
- i) Adaptive Traffic Control: Adaptive Maximum Routines, Adaptive Protected/Permissive Routines, Conditional Virtual Split Routines, Coordinated Adaptive Split Routines.
- j) Preemption / Priority Routines
- k) Standard Reports
- l) Built-In Diagnostics
- m) Time Base Control: 99 Day Programs, 10 Week Programs, 250 Events

2.29.9 Loaded Firmware

All controllers provided to the Unified Government shall have the latest revisions of both SEPAC and NTICP versions of firmware loaded. SEPAC firmware shall be activated unless otherwise stated in the plans or special conditions.

2.30 VIDEO DETECTION SYSTEM

This specification is for the provision of a stop bar video detection system Iteris that is furnished complete with cameras, detector modules, Ethernet Interface, and all cables and connectors that are required for such operation. Video Detection System shall be compatible with VRAS video detector management software and GENETEC video management system software.

2.30.1 Modular (Multi or Single Camera) Video Detection System

This specification sets forth the minimum requirements for a system that detects vehicles on a roadway using only video images of vehicle traffic.

2.30.1.1 System Hardware

The video detection system (VDS) shall consist of up to four video cameras, a video detection processor (VDP) capable of processing from one to four video sources, output extension modules, video surge suppressors and a pointing device. KCK/BPU requires the single channel option for the VDP. The two channel and four channel versions are prohibited by KCK/BPU.

Available System Configurations

- The VDS will be deployed at locations where site conditions and roadway geometry vary. The VDS system may also be deployed at locations where existing cabinets or equipment exist. Existing site configurations will dictate the availability of cabinet space and VDS usage.

- The proposed VDS shall be available in various configurations to allow maximum deployment flexibility. Each configuration shall have an identical user interface for system setup and configuration. The communications protocol to each configuration shall be identical and shall be hardware platform independent. The proposed VDS shall have multiple configurations available for deployment as described in Table 1.

Table 2.30.1.1 VDS Configuration

Description	No. Video Inputs	No. Video Outputs	Mounting Configuration	Power Requirements	Supply
Single-Channel Rack Mounted	1	1	Rack Mount (Type 170 or NEMA TS-1, TS-2 Racks)	12 or 24 VDC	Power From Rack
Dual-Channel Rack Mounted	2	1	Rack Mount (Type 170 or NEMA TS-1, TS-2 Racks)	12 or 24 VDC	Power From Rack
Quad-Channel Rack Mounted	4	1	Rack Mount (Type 170 or NEMA TS-1, TS-2 Racks)	12 or 24 VDC	Power From Rack

System Software

The system shall include software that detects vehicles in multiple lanes using only the video image. Detection zones shall be defined using only an on-board video menu and a pointing device to place the zones on a video image. Up to 24 detection zones per camera view shall be available. A separate computer shall not be required to program the detection zones.

2.30.1.2 VDP Hardware

VDP System Interfaces

The following interfaces shall be provided for each of the configurations identified in Table 1.

Video Input

Each video input shall accept RS170 (NTSC) or CCIR (PAL) signals from an external video source (camera sensor, DVD or video tape player). The interface connector shall be BNC type and shall be located on the front of the video processing unit. For four-channel VDPs, an adapter cable that converts a DB15 interface to 4 individual BNC connectors shall be used. The video input shall have the capability to be terminated into 75-ohms or high impedance (Hi-Z) using dip switches or software control from the user menu.

Video Lock LED

A LED indicator shall be provided to indicate the presence of the video signal. The LED shall illuminate upon valid video synchronization and turn off when the presence of a valid video signal is removed.

Video Output

One video output shall be provided. The video output shall be RS170 or CCIR compliant and shall pass through the input video signal. For multi-channel video input configurations, a momentary push-button shall be provided on the front panel to cycle through each input video channel. In the absence of a valid video signal, the channel shall be skipped and the next valid video signal shall be switched. The real time video output shall have the capability to show text and graphical overlays to aid in system setup. The overlays shall display real-time actuation of detection zones upon vehicle detection or presence. Overlays shall be able to be turned off by the user. Control of the overlays and video switching shall also be provided through the serial communications port. The video output interface connector shall be positive locking BNC type. Friction type (e.g. RCA type) connectors shall not be allowed.

Serial Communications

A serial communications port shall be provided on the front panel. The serial port shall be compliant with EIA232 electrical interfaces and shall use a DB9 type connector mounted on the front panel of the VDP. The serial communications interface shall allow the user to remotely configure the system and/or to extract calculated vehicle/roadway information. The interface protocol shall be documented or interface software shall be provided. The interface protocol shall support multi-drop or point-to-multipoint communications. Each VDS shall have the capability to be addressable. The VDP shall support data rates of 1200 bps to 230,400 bps, inclusive.

Contact Closure Output

Open collector (contact closure) outputs shall be provided. Four (4) open collector outputs shall be provided for the single, dual or quad channel rack-mount configuration. Additionally, the VDP shall allow the use of extension modules to provide up to 24 open collector contact closures per camera input. Each open collector output shall be capable of sinking 30 mA at 24 VDC. Open collector outputs will be used for vehicle detection indicators as well as discrete outputs for alarm conditions. The VDP outputs shall be compatible with industry standard detector racks assignments.

Logic Inputs

Logic inputs such as delay/extend or delay inhibit shall be supported through the appropriate detector rack connector pin or front panel connector in the case of the I/O module. For VDPs and extension modules, 4 inputs shall be supported via detector rack interface. The I/O module shall accommodate eight (8) inputs through a 15-pin "D" connector.

Detection LEDs

Detection status LEDs shall be provided on the front panel. The LEDs shall illuminate when a contact closure output occurs. Rack-mounted video processors shall have a minimum of four (4) LEDs. Rack-mounted extension modules shall have two (2), four (4) or eight (8) LEDs (depending upon extension module type) to indicate detection.

Test Switches

The front panel of the VDP shall have detector test switches to allow the user to manually place calls on each VDP output channel. The test switch shall be able to place either a constant call or a momentary call depending on the position of the switch.

Mouse Port

A USB mouse port shall be provided on the front panel of the rack mount video processing unit. The mouse port shall not require special mouse software drivers. The mouse port shall be used as part of system setup and configuration. A mouse shall be provided with each video processor.

Extension Module Port

Extension modules shall be connected to the VDP by an 8-wire twisted-pair cable with modular RJ45 connectors. VDP and EM communications shall be accommodated by methods using differential signals to reject electrically coupled noise.

Extension Modules

Extension modules (EM) shall be available to eliminate the need of rewiring the detector rack, by enabling the user to plug an extension module into the appropriate slot in the detector rack to provide additional open collector outputs. The extension module shall be available in both 2 and 4 channel configurations. EM configurations shall be programmable from the VDP. A separate I/O module with 32 outputs through a 37-pin "D" connector on the front panel and 8 inputs through a 15-pin "D" connector using an external wire harness for expanded flexibility shall also be available.

The VDP and EM shall be specifically designed to mount in a standard detector rack, using the edge connector to obtain power, provide contact closure outputs and accept logic inputs (e.g. delay/extend). No adapters shall be required to mount the VDP or EM in a standard detector rack. Detector rack rewiring shall not be required.

On-board Memory

The VDP shall utilize non-volatile memory technology to store on-board firmware and operational data.

Firmware Upgrade

The VDP shall enable the loading of modified or enhanced software through the EIA232 or USB port (using a USB thumb drive) and without modifying the VDP hardware.

Input Power

The VDP and EM shall be powered by 12 or 24 volts DC. VDP and EM modules shall automatically compensate for either 12 or 24 VDC operation. VDP power consumption shall not exceed 7.5 watts. The EM power consumption shall not exceed 3 watts.

Operating Temperature

The VDP shall operate satisfactorily in a temperature range from -34 °C to +74 °C and a humidity range from 0%RH to 95%RH, non-condensing as set forth in NEMA specifications.

Video Surge Suppression

A video surge suppresser shall be provided for each video input as recommended by the manufacturer of the video detection system. The surge suppresser shall be appropriately grounded to the cabinet ground rod using 14 AWG minimum.

2.30.1.3 VDP Software

General System Functions

- Detection zones shall be programmed via an on board menu displayed on a video monitor and a pointing device connected to the VDP. The menu shall facilitate placement of detection zones and setting of zone parameters or to view system parameters. A separate computer shall not be required for programming detection zones or to view system operation.

- The VDP shall store up to three different detection zone patterns in non-volatile memory. The VDP can switch to any one of the three different detection patterns within 1 second of user request via menu selection with the pointing device. Each configuration shall be uniquely labeled and able to be edited by the user for identification. The currently active configuration indicator shall be displayed on the monitor.
- The VDP shall detect vehicles in real time as they travel across each detection zone.
- The VDP shall accept new detection patterns from an external computer through the EIA232 port when the external computer uses the correct communications protocol for downloading detection patterns. A Windows®-based software designed for local or remote connection and providing video capture, real-time detection indication and detection zone modification capability shall be provided with the system.
- The VDP system shall have the capability to automatically switch to any one of the stored configurations based on the time of day which shall be programmable by the user.
- The VDP shall send its detection patterns to an external computer through the EIA232 port when requested when the external computer uses the appropriate communications protocol for uploading detection patterns.
- The VDP shall default to a safe condition, such as a constant call on each active detection channel, in the event of unacceptable interference or loss of the video signal.
- The system shall be capable of automatically detecting a low-visibility condition such as fog and respond by placing all effected detection zones in a constant call mode. A user-selected alarm output shall be active during the low-visibility condition that can be used to modify the controller operation if connected to the appropriate controller input modifier (s). The system shall automatically revert to normal detection mode when the low-visibility condition no longer exists.
- Up to 24 detection zones per camera input shall be supported and each detection zone can be sized to suit the site and the desired vehicle detection region.
- The VDP shall provide up to 24 open collector output channels per camera input using one or more extension modules.
- A single detection zone shall be able to replace multiple inductive loops and the detection zones shall be OR'ed as the default or may be AND'ed together to indicate vehicle presence on a single approach of traffic movement.
- Placement of detection zones shall be done by using only a pointing device, and a graphical interface built into the VDP and displayed on a video monitor, to draw the detection zones on the video image from each video camera. No separate computer shall be required to program the detection zones.
- When a vehicle is detected within a detection zone, a visual indication of the detection shall activate on the video overlay display to confirm the detection of the vehicle for the zone.
- Detection shall be at least 98% accurate in good weather conditions, with slight degradation possible under adverse weather conditions (e.g. rain, snow, or fog) which reduce visibility. Detection accuracy is dependent upon site geometry, camera placement, camera quality and detection zone location, and these accuracy levels do not include allowances for occlusion or poor video due to camera location or quality.
- The VDP shall provide dynamic zone reconfiguration (DZR). DZR enables normal operation of existing detection zones when one zone is being added or modified during the setup process. The new zone configuration shall not go into effect until the configuration is saved by the operator.
- Detection zone setup shall not require site specific information such as latitude and longitude to be entered into the system.
- The VDP shall process the video input from each camera at 30 frames per second. Multiple camera processors shall process all video inputs simultaneously.
- The VDP shall output a constant call during the background learning period of no more than 3 minutes.
- Detection zone outputs shall be configurable to allow the selection of presence, pulse, extend, and delay outputs. Timing parameters of pulse, extend, and delay outputs shall be user definable between 0.1 to 25.0 seconds.
- Up to six detection zones per camera view shall have the capability to count the number of vehicles detected. The count value shall be internally stored for later retrieval through the EIA232 port. The zone shall also have the capability to calculate and store average speed and lane occupancy at bin intervals of 10 seconds, 20 seconds, 1 minute, 5 minutes, 15 minutes, 30 minutes and 60 minutes.
- In addition to the count type zone, the VDP shall be able to calculate average speed and lane occupancy. These values shall be stored in non-volatile memory for later retrieval.
- The VDP shall have an "advance" zone type where detection outputs to the traffic controller are compensated for angular occlusion and distance.
- The VDP shall employ color overlays on the video output.

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- The VDP shall have the ability to show phase status (green, yellow, or red) for up to 8 phases. These indications shall also be color coded.
- The user shall have the ability to enable or disable the display of the phase information on the video output.
- For alpha numeric user inputs, the VDP shall utilize a virtual keyboard on the video overlay system to ease user input. The virtual keyboard shall use the standard QWERTY keyboard layout.
- The VDP shall aid the user in drawing additional detection zones by automatically drawing and placing zones at appropriate locations with only a single click of the mouse. The additional zone shall utilize geometric extrapolation of the parent zone when creating the child zone. The process shall also automatically accommodate lane marking angles and zone overlaps.
- When the user wishes to modify the location of a zone, the VDP shall allow the user move a single zone, multiple zones or all zones simultaneously.
- When the user wishes to modify the geometric shape of the zone, the VDP shall allow the user to change the shape by moving the zone corner or zone sides.
- On screen zone identifiers shall be modifiable by the user. The user shall be allowed to select channel output assignments, zone type, input status, zone labels or zone numbers to be the identifier.
- For multiple camera input VDPs, the user shall have the ability to enable automatic video output switching. The dwell time for each video input shall be user programmable.

2.30.1.4 VDS Camera Sensor

To accommodate deployment flexibility, the VDS camera sensor shall be compatible will all VDP platforms identified in Table 1. The VDS camera sensor shall be supplied by the VDS manufacturer.

- The advanced camera enclosure shall utilize Indium Tin Oxide (ITO) technology for the heating element of the front glass. The transparent coating shall not impact the visual acuity and shall be optically clear.
- Cable terminations at the camera for video and power shall not require crimping or special tools. The video termination shall only require a coax stripper and a screw driver. No connectors (e.g. BNC) shall be required. The power termination shall only require a standard wire stripper and screw driver.
- The camera sensor shall allow the user to set the focus and field of view either at the camera sensor or from the controller cabinet. Camera sensor control from the controller cabinet shall communicate over the coaxial cable. No additional wires shall be required.
- The camera shall produce a useable video image of the bodies of vehicles under all roadway lighting conditions, regardless of time of day. The minimum range of scene luminance over which the camera shall produce a useable video image shall be the minimum range from nighttime to daytime, but not less than the range 0.003 lux to 10,000 lux.
- The camera electronics shall include automatic gain control (AGC) to produce a satisfactory image at night.
- The imager luminance signal to noise ratio (S/N) shall be more than 50 dB with the automatic gain control (AGC) disabled.
- The imager shall employ three dimensional dynamic noise reduction (3D-DNR) to remove unwanted image noise.
- The camera imager shall employ wide dynamic range (WDR) technology to compensate for wide dynamic outdoor lighting conditions. The dynamic range shall be greater than 100 dB.
- The camera shall be digital signal processor (DSP) based and shall use a CCD sensing element and shall output color video with resolution of not less than 540 TV lines. The color CCD imager shall have a minimum effective area of 811 (h) x 508 (v) pixels.
- The camera shall include an electronic shutter control based upon average scene luminance and shall be equipped with an auto-iris lens that operates in tandem with the electronic shutter. The electronic shutter shall operate between the range of 1/60th to 1/90,000th second.
- The camera shall utilize automatic white balance.
- The camera shall include a variable focal length lens with variable focus that can be adjusted, without opening up the camera housing, to suit the site geometry by means of a portable interface device designed for that purpose and manufactured by the detection system supplier.
- The horizontal field of view shall be adjustable from 2.4 to 58 degrees. This camera configuration may be used for the majority of detection approaches in order to minimize the setup time and spares required by the user. The lens shall be a 27x zoom lens with a focal length of 3.25mm to 88.0mm.
- The lens shall also have an auto-focus feature with a manual override to facilitate ease of setup.
- The camera shall incorporate the use of preset positioning that store zoom and focus positioning information. The camera shall have the capability to recall the previously stored preset upon application of power.
- The camera shall be housed in a weather-tight sealed enclosure. The enclosure shall be made of 6061 anodized aluminum. The housing shall allow the camera to be rotated to allow proper alignment between the camera and the traveled road surface.
- The camera enclosure shall be equipped with a sunshield. The sunshield shall include a provision for water diversion to prevent water from flowing in the camera's field of view. The camera enclosure with sunshield shall be less than 6" diameter, less than 18" long, and shall weigh less than 6 pounds when the camera and lens are mounted inside the enclosure.
- The enclosure shall be design so that the pan, tilt and rotation of the camera assembly can be accomplished independently without affecting the other settings.
- The camera enclosure shall include a proportionally controlled Indium Tin Oxide heater design that maximizes heat transfer to the lens. The output power of the heater shall vary with temperature, to assure proper operation of the lens functions at low temperatures and prevent moisture condensation on the optical faceplate of the enclosure.

- The glass face on the front of the enclosure shall have an anti-reflective coating to minimize light and image reflections.
- When mounted outdoors in the enclosure, the camera shall operate satisfactorily in a temperature range from -34 °C to +60 °C and a humidity range from 0% RH to 100% RH. Measurement of satisfactory video shall be based upon VDP system operation.
- The camera shall be powered by 120-240 VAC @ 50/60 Hz. Power consumption shall be 5 watts typical and 25 watts or less under worst conditions.
- Recommended camera placement height shall be 33 feet (or 10 meters) above the roadway, and over the traveled way on which vehicles are to be detected. For optimum detection the camera should be centered above the traveled roadway. The camera shall view approaching vehicles at a distance not to exceed 350 feet for reliable detection (height to distance ratio of 10:100) . Camera placement and field of view (FOV) shall be unobstructed and as noted in the installation documentation provided by the supplier.
- The camera shall provide 2 options for set up, diagnostic testing, and viewing of video. A lens adjustment module (LAM) supplied by the VDP supplier, when connected directly to the camera shall allow set up, diagnostic testing, and viewing of video while the camera is installed on a mast arm or pole. The (LAM) shall also allow set up, diagnostic testing, and viewing of the video from the cabinet when connected to the coaxial cable.
- The video signal shall be fully isolated from the camera enclosure and power cabling
- Cable terminations at the camera for video and power shall not require crimping tools.
- A weather-proof protective cover shall be provided shall be provided to protect all terminations at the camera. No special tooling shall be required to remove or install the protective cap.

2.30.1.5 Installation

- The hybrid coaxial power cable to be used between the camera and the VDP in the traffic cabinet shall be per Manufacturer specifications. This cable shall be suitable for installation in conduit or overhead with appropriate span wire. BNC plug connectors shall be used where applicable. The cable, BNC connector, and crimping tool shall be approved by the supplier of the video detection system, and the manufacturer's instructions must be followed to ensure proper connection.
- The power cabling shall be 16 AWG three-conductor cable with a minimum outside diameter of 0.325 inch and a maximum diameter of 0.490 inch. The cabling shall comply with the National Electric Code, as well as local electrical codes. Cameras may acquire power from the luminaire if necessary.
- The video detection camera shall be installed by factory-certified installers as recommended by the supplier and documented in installation materials provided by the supplier. Proof of factory certification shall be provided.

2.30.1.6 Warranty

- The supplier shall provide a limited three-year warranty on the video detection system.
- During the warranty period, technical support shall be available from the supplier via telephone within 4 hours of the time a call is made by a user, and this support shall be available from factory-certified personnel or factory-certified installers.
- During the warranty period, updates to VDP software shall be available from the supplier without charge.

2.30.2 Color Video Detection Camera w/o Connectors

This specification sets forth the minimum requirements for cameras that are to be used by video detection systems

2.30.2.1 Video Detection Camera

- Video detection cameras used for traffic detection 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 bodies of vehicles under all roadway lighting conditions, regardless of time of day. The minimum range of scene luminance over which the camera shall produce a useable video image shall be the minimum range from nighttime to daytime, but not less than the range 1.0 lux to 10,000 lux.
- The imager luminance signal to noise ratio (S/N) shall be more than 50 dB.
- The camera shall be digital signal processor (DSP) based and shall use a ¼ inch EX view hole accumulation diode (HAD) CCD sensing element and shall output color video with resolution of not less than 530 TV lines. The CCD imager shall have a minimum effective area of 768 (h) x 494 (v) pixels.
- The camera shall include an electronic shutter control based upon average scene luminance and shall be equipped with an auto-iris lens that operates in tandem with the electronic shutter.
- The camera shall utilize automatic white balance.
- The camera shall include a variable focal length lens with variable focus that can be adjusted, without opening up the camera housing, to suit the site geometry by means of a portable interface device designed for that purpose and manufactured by the detection system supplier.
- The horizontal field of view shall be adjustable from 4.6 to 46.0 degrees. This camera configuration may be used for the majority of detection approaches in order to minimize the setup time and spares required by the user. The lens shall be a 10x zoom lens with a focal length of 4.2 mm to 42.0 mm.

- The lens shall also have an auto-focus feature with a manual override to facilitate ease of setup.
- The camera shall incorporate the use of preset positioning that store zoom and focus positioning information. The camera shall have the capability to recall the previously stored preset upon application of power.
- The camera electronics shall include automatic gain control (AGC) to produce a satisfactory image at night.
- The camera shall be housed in a weather-tight sealed enclosure. The enclosure shall be made of 6061 anodized aluminum. The housing shall be field rotatable to allow proper alignment between the camera and the traveled road surface.
- The camera enclosure shall be equipped with a sunshield. The sunshield shall include a provision for water diversion to prevent water from flowing in the camera's field of view. The camera enclosure with sunshield shall be less than 6" diameter, less than 18" long, and shall weigh less than 6 pounds when the camera and lens are mounted inside the enclosure.
- The enclosure shall be design so that the pan, tilt and rotation of the camera assembly can be accomplished independently without affecting the other settings.
- The camera enclosure shall include a proportionally controlled Indium Tin Oxide heater design that maximizes heat transfer to the lens. The output power of the heater shall vary with temperature, to assure proper operation of the lens functions at low temperatures and prevent moisture condensation on the optical faceplate of the enclosure.
- The glass face on the front of the enclosure shall have an anti-reflective coating to minimize light and image reflections.
- The glass face shall also employ a special coating to minimize the buildup of environmental debris such as dirt and water.
- When mounted outdoors in the enclosure, the camera shall operate satisfactorily in a temperature range from -34 °C to +60 °C and a humidity range from 0% RH to 100% RH. Measurement of satisfactory video shall be based upon VDP system operation.
- The camera shall be powered by 120-240 VAC @ 50/60 Hz. Power consumption shall be 30 watts or less under all conditions.
- Recommended camera placement height shall be 33 feet (or 10 meters) above the roadway, and over the traveled way on which vehicles are to be detected. For optimum detection the camera should be centered above the traveled roadway. The camera shall view approaching vehicles at a distance not to exceed 350 feet for reliable detection (height to distance ratio of 10:100) . Camera placement and field of view (FOV) shall be unobstructed and as noted in the installation documentation provided by the supplier.
- The camera shall provide 2 options for set up, diagnostic testing, and viewing of video. A lens adjustment module (LAM) supplied by the VDP supplier, when connected directly to the camera shall allow set up, diagnostic testing, and viewing of video while the camera is installed on a mast arm or pole. The (LAM) shall also allow set up, diagnostic testing, and viewing of the video from the cabinet when connected to the coaxial cable.
- The video signal shall be fully isolated from the camera enclosure and power cabling
- Cable terminations at the camera for video and power shall not require crimping tools.
- No BNC or other connector shall be used for the coaxial video cable termination at the camera.
- The power connection at the camera shall use connector terminations that only require the use of wire strippers and a standard screwdriver. No special crimping tools or other types of terminations shall be used.
- A weather-proof protective cover shall be provided shall be provided to protect all terminations at the camera. No special tooling shall be required to remove or install the protective cap.

2.30.2.2 Installation

- The hybrid coaxial power cable to be used between the camera and the VDP in the traffic cabinet shall be per Manufacturer specifications. This cable shall be suitable for installation in conduit or overhead with appropriate span wire. A BNC plug connector shall be used at the cabinet end. The coaxial video cable shall be stripped and terminated at the camera and cabinet per manufacturers' instructions (no BNC or other connector shall be used at the camera) . The coaxial cable, BNC connector used at the cabinet termination, and crimping tool shall be approved by the supplier of the video detection system. The manufacturer's instructions must be followed to ensure proper connection.
- The power cabling shall be 16 AWG three conductor cable with a minimum outside diameter of 0.325 inch and a maximum diameter of 0.490 inch. The power cable shall be terminated at the camera per manufacturers' instructions and shall only require standard wire strippers and a screw driver for installation (no special connectors or crimping tools shall be used for installation) . The cabling shall comply with the National Electric Code, as well as local electrical codes. Cameras may acquire power from the luminaire if necessary.
- The video detection camera shall be installed by factory-certified installers as recommended by the supplier and documented in installation materials provided by the supplier. Proof of factory certification shall be provided.

2.30.2.3 Limited Warranty

- The supplier shall provide a limited three-year warranty on the video detection camera. See suppliers standard warranty included in the Terms and Conditions of Sale documentation.
- During the warranty period, technical support shall be available from the supplier via telephone within 4 hours of the time a call is made by a user, and this support shall be available from factory-certified personnel or factory-certified installers.

2.30.3 Rack Mounted Video Detection Single Point Interface Ethernet Device with MPEG/H.264 Video Streaming

This specification sets forth the minimum requirements for a module that provides a single point interface to multiple rack-mounted video detection units. This module shall also have the capability to stream up to 4 simultaneous video streams over an Ethernet interface.

2.30.3.1 Functional Capabilities

- The interface device shall provide capabilities to enable multiple rack-mounted video detection processors to be locally and remotely accessed from a single point via one set of user interface devices. User interface devices are defined as a pointing device (mouse or track-ball) and video monitor.
- Up to four video detection processor chains (video detection processor and extension modules) shall be accommodated.
- The device shall allow the operator to switch video output display for any of the attached rack-mounted video detection processors by pressing a momentary switch or by using the remote access software.
- Local user access to video detection programming shall be limited to the detection processor unit that is currently being displayed on the monitor.
- All local programming and setup parameters for the video detection processor shall be user accessible through the interface unit without requiring the user to swap user interface cables between video detection processors.
- Remote access to the device shall be through the built-in Ethernet port or EIA-232 port via access software running on a Microsoft Windows based personal computer.
- An internet browser-based remote access firmware shall also be available for remote setup and diagnostics of the interface unit.
- The interface unit shall support streaming video technology using MPEG4 and H.264 standards to allow the user to monitor video detection imagery over the Ethernet interface. Motion JPEG streaming video shall not be allowed.
- The user shall be able to select which video input to be displayed on the output video monitor by repeatedly depressing the menu button.
- The user shall be able to select a quad view of all of the four cameras simultaneously on the output video monitor by depressing the menu button.
- The interface unit shall allow four independent streams, one from each video detection processor, to be transported via Ethernet to four independent streaming video players simultaneously in CIF resolution.
- The interface unit shall also have a browser interface that allows the user to configure the module.
- The browser interface shall also allow the user to view the streaming video on the browser interface.
- The browser interface shall allow the user to select the resolution of the displayed streamed video.
- The interface unit shall support the streaming and display of D1, CIF, QCIF, VGA and QVGA video resolutions in a single stream or four concurrent streams in CIF resolution.
- The interface unit shall allow the user to select a quad-view of all four input video signals to be shown on the browser interface.
- The interface unit shall allow the user to manage the unit's Ethernet bandwidth usage by allowing the user to select the maximum bandwidth limit between 256 kbps and 7.0 Mbps.
- The browser interface shall allow the user to change the unit's Ethernet network settings of IP address, subnet mask and default gateway.
- The interface unit shall allow the user to upload new application firmware through the use of the browser interface.
- Access to the interface unit shall be under password control and the browser interface shall allow the user to change the password.
- The interface unit shall have the capability to perform IP port redirecting between the remote management software and each attached video detection processor. A unique IP port number shall be assigned for each video detection interface. The port number shall not be identical to the web browser interface of 80.

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2.30.3.2 Interface Device Hardware

- The interface device shall be specifically designed to mount in a standard TS-1, TS-2, and 170 type detector rack, using the edge connector to obtain power. No adapters shall be required to mount the interface device in a standard detector rack.
- The interface device shall occupy no more than two slots in the detector rack and shall provide a loop-type handle for easy installation and removal.
- The interface device shall be powered by 12 or 24 volts DC and shall not consume more than 6.25 watts. The unit shall automatically compensate for the different input voltages and shall be hot-swappable.
- The interface device shall operate in a temperature range from -35°C to +74°C and a humidity range from 0% RH to 95% RH, non-condensing.
- Video Ports - The interface unit shall accommodate a maximum of four composite video inputs and one video output.

- Video inputs and video output shall be made via BNC connectors to ensure secure connections. RCA or other straight friction plug-in type connections shall not be allowed. Video inputs shall use a vendor supplied "octopus" cable to accommodate the four video inputs. Provisions shall be made to accommodate the mating cable to utilize jack screws for securing the octopus cable.
- The interface unit shall accommodate either monochrome or color video signals conforming to NTSC or PAL video standards.
- The interface unit shall automatically sense the video input signal and configure the video output port to either NTSC or PAL standards. Each video input signal shall be separately sensed to allow mixed video signals.

- The interface unit shall interface with up to four video detection processors using RJ-45 interface connectors.
- The interface unit shall support the use of USB pointing devices. The unit shall support either a USB mouse or trackball. Pointing devices shall not require vendor specific pointing device software drivers.
- An EIA-232 communications port shall be provided for local and remote access. The connector for this port shall be a 9-pin "D" subminiature connector on the front of the interface unit. Provisions shall be made to accommodate mating cables to utilize jack screws for securing cables.
- Hi-intensity LED status lights shall be provided to facilitate system monitoring. Indicators shall be provided to show the status of the internal processor, video lock and indication of which video input is being monitored.
- An Ethernet port shall be integrated within the interface unit. The Ethernet port shall conform to 802.3 Ethernet specifications and shall auto-sense between 10 and 100 Mbps data rates. Industry standard TCP/IP (UDP and TCP packets) protocol shall be supported. The Ethernet connection shall be made through a RJ-45 connector.

2.30.3.3 Limited Warranty

- The supplier shall provide a limited three-year warranty on the video detection system. See suppliers standard warranty included in the Terms and Conditions of Sale documentation.
- During the warranty period, technical support shall be available from the supplier via telephone within 4 hours of the time a call is made by a user, and this support shall be available from factory-certified personnel or factory-certified installers.

2.31 LOOP DETECTOR SYSTEM

Inductive loops are rarely used in current projects for the UG unless they are currently in use at a location and there are insufficient resources to upgrade to less intrusive detection methods. A typical rare occurrence for inductive loops may require recutting loops for existing detectors or provision of detector cards for existing loops that are to be reused. Since these are maintenance scenarios and there is a need to minimize inventory brands, BPU has standardized on two detector units. The LMD622 detector is used for standard presence operation. The LMD622t detector is used where extend and delay functionality is required. The specific detector card that may be required for a particular project will be defined on the plans. The cabinet wiring specifications above, indicate that TS-2 card rack installations are utilized.

2.32 WIRELESS BATTERY MAGNETOMETER VEHICLE DETECTION SYSTEM

This specification sets forth the minimum specifications for a system that detects vehicles on a roadway using battery powered magnetometers utilizing wireless communications to transmit detection information to the controller. The Wireless Battery Powered Magnetometer Vehicle Detection System (VDS) shall consist of one or more Vehicle Sensor Nodes (VSN) per lane, wireless repeaters (RP) mounted on the side of the roadway, one or more Access Points (AP) mounted on the side of the roadway, and Contact Closure (CC) and Extension (EX) Interface Card. Communications between the VSN and the AP shall be wireless.

2.32.1 Functional Capabilities

- The VSN shall detect a vehicle by measuring a change in the earth's magnetic field near the VSN caused by the vehicle (i.e. magnetometer type detection)
- The VSN shall transmit detection information within 125ms of a detected event.
- The VSN shall automatically recalibrate in the event of a detector lock.
- Each VDS system shall consist of one or more VSN's per lane located as identified on the intersection plans.
- Communications between the VSN and the AP shall be wireless.
- The RF link among the AP, RP, and VSN shall conform to the following:
 - The RF link shall utilize an IEEE approved wireless communications protocol.
 - Communications is allowed only in an unlicensed band.

- The VSN and RP shall be reconfigurable by a user over the wireless interface to avoid interference from other users of the communications band. A minimum of 16 channels shall be provided for this purpose.
 - The RF link budget shall be 93dB or greater.
 - The AP to VSN (or RP to VSN) RF range shall be at least 150 feet for an AP/RP installed at 24 feet above the roadway and at least 100 feet at 18 feet above the roadway.
 - The RP to AP RF range shall be at least 750 feet when both units are installed 18 feet above the roadway.
- Each VSN shall transmit a unique identifying code.
- The VSN shall respond within 100 seconds when the AP is powered on.
- When no AP is present or is powered off, the VSN is not required to detect vehicles.
- The AP shall have the capability to transmit detection information to a 170, 2070, or NEMA traffic controller to provide real time detection information via a standard contact-closure based input shelf.
- The VSN, RP and AP shall be capable of accepting software and firmware upgrades.

2.32.2 VSN Hardware

- The VSN shall consist of a 3 Axis magnetometer, a microprocessor, a wireless transmitter and receiver, and a battery.
- The VSN components shall be contained within a single housing.
- The VSN housing shall NEMA 6P and IP68 standards.
- The VSN components shall be fully encapsulated within the housing to prevent moisture from degrading the components.
- The VSN shall be able to operate at temperatures from -37°F to +176°F.
- The VSN housing shall be capable of being installed in a 4" diameter 2-1/4" deep cored hole.
- The VSN shall be designed to operate from its battery for a period of 9 or ten years of life under normal traffic conditions after it is put into operation.
- As an option, the VSN shall be able to transmit the complete X-Y-Z magnetic signature of a vehicle, sampled at a minimum of 128 samples per second. In this mode, the VSN shall be designed to operate from its battery for a minimum of 1 year.

2.32.3 AP Hardware

- The AP shall be the communication hub of the sensor network.
- The AP shall be able to communicate to up to 24 VSN's.
- The AP shall be powered via 48V DC, 3W or via non-isolated external 10 to 15V DC, 2W power. Power shall be provided by the CC Contact Closure Card.
- The AP shall have at least one powering option that provides 1500V isolation and 5KV surge protection.
- The AP shall operate in the -37°F to +176°F temperature range.
- The AP shall meet NEMA 4X and IP67 standards
- The AP shall weigh no more than 3 lbs.
- The AP shall communicate to the controller via the CC and optional EX Contact Closure Board (s) .

2.32.4 Repeater Hardware

- If required, a RP shall be provided.
- The RP shall extend the effective communication range of the sensor to the AP an additional 750'.
- The RP shall be battery powered.
- The RP battery shall be field replaceable.
- The RP shall operate in the -37°F to +176°F temperature range.
- The RP shall meet NEMA 4X and IP67 standards
- The RP shall weigh no more than 3 lbs.

2.32.5 CC and EX Contact Closure Cards

- The CC and EX cards shall provide detector outputs to the controller.
- The CC shall communicate with the AP via an Ethernet cable.
- The CC and EX shall directly plug in to standard 170/2070 Input Files and NEMA detector racks.
- Each CC and EX cards shall provide up to 4 channels of detection.
- The CC and EX shall be able to provide pulse or presence detection outputs.
- The CC and EX card shall provide for up to 31 seconds of delay
- The CC and EX card shall provide up to 7.5 seconds of extension.
- The front panel of the CC and EX cards shall provide:
 - Status LED's displaying
 - Detection Channel Status
 - Line Quality
 - Fault Monitor
 - Ten Configuration DIP switches to enable
 - Presence or Pulse mode
 - Delay
 - Extension
 - Rotary Switch to program time functions for delay and extension functions
 - Two Ethernet style RJ45 connectors
- The CC and EX cards shall be powered by 11 to 26 VDC
- The CC card shall provide power to the AP over the Ethernet cable.
- The CC and EX cards shall be surge protected to GR-1089 standards
- The CC and EX cards shall operate -37°F to +176°F temperature range.
- The CC and EX cards shall operate in up to 95% humidity (non-condensing)
- The Access Box shall provide a communication link between the AP and CC.
- The Access Box shall provide the ability for remote communications.
- The Access Box shall have 3 Ethernet style RJ45 connectors.
- The Access Box shall not exceed 2-3/8" x 1-1/2" x 7/8" in size.

2.32.6 Configuration Software

- The VDS shall include the software necessary to configure the VSN.
- The VDS shall include the software necessary to configure the RP.
- The VDS shall include the software necessary to configure the AP.
- The VDS shall include the software necessary to store and retrieve detection data.

2.32.6 Configuration Software

- The VDS shall include the software necessary to configure the VSN.
- The VDS shall include the software necessary to configure the RP.
- The VDS shall include the software necessary to configure the AP.
- The VDS shall include the software necessary to store and retrieve detection data.

2.32.7 Limited Warranty

- The supplier shall provide a limited two-year warranty on the detection system.
- During the warranty period, technical support shall be available from the supplier via telephone within 24 hours of the time a call is made by a user, and this support shall be available from factory-authorized personnel or factory-authorized installers.
- During the warranty period, standard updates to the software shall be available from the supplier without charge.

2.33 2 WIRE ACCESSIBLE PEDESTRIAN SIGNAL (APS)

The Audible-Tactile Pedestrian Signal System shall consist of all electronic control equipment, mounting hardware, push buttons and signs, which are designed to provide both a push button with a raised vibrating tactile arrow on the button, along with a variety of audible sounds for different pedestrian signal functions.

The System shall be manufactured by an ISO 9001:2008 registered company. The System shall meet the requirements of Made in America and/or The Buy American Act.

2.33.1 Design Compliance

Substantiating documentation for meeting ISO, NEMA, IEC, and FCC requirements must be supplied from an outside Testing Services Laboratory.

- The System shall meet the functionality requirements of MUTCD 2009 4E.
- The System shall meet NEMA TS 2 Section 2.1 Temperature & Humidity requirements.
- The System shall meet NEMA TS 2 Section 2.1 Transient Voltage Protection requirements.
- The System shall meet NEMA TS 2 Section 2.1 Mechanical Shock and Vibration requirements.
- The System shall meet IEC 61000-4-4, IEC 61000-4-5 Transient Suppression requirements.
- The System shall meet FCC Title 47, Part 15, Class A Electronic Noise requirements.
- The Push Button Station (PBS) Enclosure shall meet NEMA 250 Type 4X Enclosure requirements.
- The Central Control Unit (CCU) & Ped Station Monitor (PSM) Enclosures shall meet NEMA 250 Type 1 requirements.
- The System shall meet NEMA TS 4 Electrical Reliability requirements (applicable portions of Section 8) .

2.33.2 Specifications - Accessible Pedestrian Signal Units

Ensure APS complies with US Access Board's "Draft Guidelines for Accessible Public Rights of Way (PROWAG) Section R306. In addition, ensure that the APS complies with and provides operation consistent with requirements of Sections 4E.09 through 4E.13 of the 2009 Edition of the Federal Highway Administration publication Manual on Uniform Traffic Control Devices.

Supply an APS (pushbutton station) that includes a pedestrian sign, a pushbutton, vibrotactile arrow, an ambient noise sensing microphone, and an audible speaker contained in one unit and with the following features:

- Vibrating tactile arrow with high visual contrast, located on the actual push button, not separate on the push button unit.
- PUSH BUTTON: ADA compliant with raised arrow on the button plunger. The arrow on the PBS shall be able to be changed to one of four directions.
- PUSH BUTTON: Uses Piezo switch technology rated to greater than 20 million operations.
- All audible sounds shall emanate from the PBS.
- Pushbutton locator tone with duration of 0.15 seconds or less, repeating at 1-second intervals. The pushbutton locator tones must deactivate when the traffic control signal is operating in a flashing mode. The locator tones must be intensely responsive to ambient sound and be audible (a maximum of 5 dBA louder than ambient sound) up to 6 to 12 feet from the pushbutton or to the building line whichever is less.
- Optional Speech walk message for the WALKING PERSON (symbolizing WALK) indication.
- Optional Speech pushbutton information message.
- Audible tone walk indications consisting of ticks repeating at 8 to 10 times per second at multiple frequencies with a dominant component at 880 Hz ±20%. It must provide an audible walk indication during the walk interval only.
- The System shall provide two language capabilities, selectable by user (as a custom feature) .
- The System shall provide Emergency preemption message in conjunction with a preemption system (selectable feature) .
- LOCATE tone and "Walk", "Pedestrian Clearance" audible feature must have independent settable minimum and maximum volume limits.
- The System shall be able to be set to vibrate a tactile arrow button during the WALK interval following a button push and/or every time the walk comes up.
- The System shall have the field-selectable function known as "Locating Tone". This means that during the FLASHING DON'T WALK and the DON'T WALK intervals, the system shall provide a locating tone that emanates from the Pedestrian Push Button Station. The system shall provide at least three different sounds to choose from.

- The System shall have the field selectable function known as "Extended Push Activation". This means that the audible WALK message will only be activated and sound during the WALK interval if the button is depressed for a field selectable minimum period of time (from 0 to 6 seconds) . Also, for the following walk phase, the volumes have a separately settable minimum and maximum volume level.
- The System shall have the field selectable function known as "Informational Message". This means that a custom message giving the location of the street to cross and the intersection (or other information) will be vocalized only when the button is depressed for a minimum field selectable time.
- The System shall provide a "Wait" message that plays once the button is activated until the walk cycle goes into effect. This message must have the field selectable option of OFF or playing every 4, 6, 8 or 10 seconds.
- The System shall have standard "Travel Direction" options that can be selected at the time of installation.
- The System shall have at least five field selectable walk sound options including a cuckoo, a chirp, a rapid tick or custom voice message.
- The System shall provide 3 Ped-clearance sound choices including audible countdown (field selectable) . The audible countdown shall represent the time remaining during the pedestrian clearance interval. Timing is automatically adjusted to CLEARANCE INTERVAL timing.
- All sounds for all PBS, s must be synchronized.
- The system shall have an ambient sensing microphone located in the pedestrian station in a non-visible, environmentally protected housing.
- Automatic volume adjustment in response to ambient traffic sound level provided up to a maximum volume of 100 dBA.
- The pushbutton must be ADA compliant and activate both the walk interval and accessible pedestrian signal.
- Actuation indicator-tone and light.
- Pushbutton station and Central Control Unit shall be rated for the following temperature range: -34C to +74C (-29F to +165F) .
- CONFLICT WALK MONITOR: Circuitry shall have a separate microcontroller that independently monitors the main microcontroller outputs and, Walk Mode, for conflict condition, the PBS is reset in case of a conflict detection.
- Unless specified otherwise in the plans, supply a central control unit (CCU) for the pushbutton stations that resides in the Traffic Signal Controller Cabinet. Provide a CCU capable of controlling up to 4 pedestrian phases and 16 Pushbutton stations. Ensure that all inputs and outputs on the CCU have Transient Voltage Protection. Shall be provided with an interface connection board. Shall have Ethernet access to PBS, s through the CCU to be able to change the settings of PBS as well as monitor the self-test Events of the PBS, s and report back to the Central Control Station. Shall have internal memory to store a few hundred events with a date-time stamp for each event. Shall have an internal real-time clock capable of updating and synchronizing its time with an NTP server. Shall provide user settable information to the user including location, contact information and system name via SNMP protocol. Shall have the ability to send system Trap messages for any event logged in the system health log to up to three separate IP addresses using SNMP protocol. Shall provide a user settable calendar function allowing four separate configuration profiles to be configured to become active at different times of the day on a daily, weekly, or holiday basis.

2.33.3 Optional Desirable Features

- The firmware and voice messages shall be upgradeable via a PC standard USB port at the PBS. There shall be no requirement for the IC chips or module hardware to be removed or exchanged in order to complete a firmware update.
- Use of field replaceable fuses is unacceptable. All fuses and overload protection circuits shall be solid state, and self-resetting in the event of overload.
- All field selectable options shall be set and adjusted using a vendor supplied infrared remote programmer or Laptop USB port, without use of potentiometer or hardware adjustments. All USB adjustments shall include a Windows XP/7/Vista PC-based program with password security.
- The system shall work with the vendor Windows XP/7/Vista PC-based program to allow time of day (TOD) , week, month & holiday programming, with a minimum of 4 TOD alternate programs.
- The system shall have an event tracking log, accessible via the vendor's Windows XP/7/Vista PC-based program, to allow downloading of the time stamped event data.

2.34 FIBER OPTIC HUB CABINET

Fiber optic hub cabinets shall be provided in two different configurations defined as "Single Wide" and "Double Wide" as specified by the plan documents.

All cabinets shall be of welded construction, fabricated of 0.12" natural aluminum with no sharp edges or burrs and shall offer a clean, workmanlike appearance.

Single wide cabinets shall be provided with front and rear doors which shall occupy almost all of the front and rear of the cabinet to allow unrestricted access to the cabinet interior. Cabinets shall have approximate overall dimensions of 64" H X 24 1/4" W X 20 1/4" D. The rear door shall include louvers and an air filter to allow for ventilation.

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<p>TRAFFIC SIGNAL SPECIFICATIONS</p> <p>SHEET 7 OF 9</p> <p>CITY OF KANSAS CITY, KANSAS</p> <p>PUBLIC WORKS DEPARTMENT</p> <p>TRAFFIC DIVISION</p>					
		DESIGNED: KCK	DRAWN: B&McD		
		CHECKED: B&McD	DATE: 3/20/2017		
		SCALE: N/A	SHEET NO.:		

Double wide cabinets shall be provided with four doors occupying almost all of the front and rear portions of the cabinet. The cabinet shall have approximate overall dimensions of 66" H X 44½" W X 26" D. One door on both the front and rear of the cabinet shall be equipped with louvers and air filters for ventilation.

All doors shall be equipped with stainless steel hinges, three point latching mechanisms, stainless steel latch operator handles having means to allow the use of an external padlock and shall be fitted with "standard" traffic signal cabinet, Corbin style tumbler locks operated by standard 1R6380 traffic signal cabinet keys.

The roofs of both type cabinets shall include vent openings designed to preclude the entrance of water.

The interior of the cabinets shall be fitted with standard 19" EIA equipment racks. Single wide cabinets shall include one equipment rack. Double wide cabinets shall include two equipment racks. Racks shall provide equipment mounting facility for essentially the entire height of the cabinet.

All cabinets shall include thermostatically controlled vent fan (s) ; one in the case of single wide cabinets, two for double wide cabinets. Fan (s) shall be mounted to removable panels located under the previously described roof vents. Fans shall be ball bearing type rated at 100 CFM.

The tops of each type cabinet shall be fitted with front and rear fluorescent lights controlled by door operated refrigerator switches. All doors shall be equipped with these switches which shall provide power to the front or rear light as appropriate.

All cabinets shall include a power distribution panel mounted between the front and rear rails at the bottom of the equipment rack. The power distribution panel shall include a heavy duty, three position, pressure type terminal strip for the connection of incoming AC power; a safety ground connection, a lightning arrester, a 30 amp main circuit breaker, a GFI duplex service power receptacle and two duplex equipment receptacles. A 15amp circuit breaker shall control power to the GFI service receptacle only; a second 15 amp circuit breaker shall control power to the equipment receptacles, cabinet lights and fan (s) .

The lightning arrester shall be of the hybrid type rated at 20,000 amps and capable of clamping such a surge to a peak of not greater than 250 volts without regard for the rise time of the surge. The arrester shall be totally of solid state design, with no gas tube type devices of any kind and shall be a two stage unit providing separate protection for the controller and monitor unit. It shall incorporate a base or socket portion which shall permanently mount to the power distribution panel. The arrester device itself will plug connect to that base to allow for rapid replacement in the event the arrester is damaged by a lightning strike. A minimum 200 microhenry inductor shall be incorporated between the equipment line in and equipment line out terminals. The arrester shall be epoxy encapsulated in a flame retardant material. The arrester shall also include indicator lights to signify the condition of the arrester, as well as a set of dry contacts which shall be wired to a "D" panel alarm input terminal to provide a remote notification of a failed arrester. Lightning arrester units shall mate with EDCCO base / socket module model SHA1250-BASE.

All cabinets shall include a pull out type plan drawer providing approximately 1½" of storage space mounted to the equipment rack as high as practical. All cabinets shall include a rack mounted power bar assembly having a minimum of eight outlets spaced and oriented such that all outlets will be available for use with "cube" style equipment power supplies.

Equipment racks shall be fitted with fiber optic distribution / termination housing and splice housings.

The following complement of fiber optic components, listed from top to bottom, shall be provided in each rack:
CCH-04U, CSH-03U, CCH-04U, CSH-03U, CCH-04U, CSH-03U
All components shall be spaced to allow unrestricted access to all pull out trays, drop down doors etc.

Each CSH-04U shall include a full complement of twelve, CCH-CP06-19T six position bulkhead connector panels having ceramic ST type connectors suitable for use with both single mode and multi- mode fiber optic conductors.

Each CSH-03U shall include a full complement of eight M-67-048 splice trays.

All cabinets shall include anchor bolts.

2.35 ETHERNET NETWORK SYSTEM COMPONENTS

Ethernet Network System Components including Ethernet switches and other related materials and equipment are not defined in these general specifications. When required, these items will be defined in special conditions for each specific project. For projects that do require expansion or modification of the Ethernet Network, a qualified System Integrator with qualified personnel will be required to program such devices and activate them on the network. This work must be in coordination with BPU Electrical Engineering Department and the UG's Department of Technology Services.

2.36 ADVANCED TRAFFIC MANAGEMENT SYSTEM (ATMS) and INTELLIGENT TRANSPORTATION SYSTEM (ITS)

ATMS and ITS items such as Pan/Tilt/Zoom cameras, messaging systems, traffic responsive systems and traffic adaptive systems are not defined in these general specifications. When required, these items will be defined in special conditions for each specific project. Such systems will require the use of a qualified System Integrator who has knowledge of the existing ATMS / ITS system and how to integrate new deployments into the existing systems.

2.37 SPAN WIRE ASSEMBLIES: All messenger cable, tether cable, guy wire, down guy anchors and cable clamps shall conform to the requirements of the Standard Drawings or as may be listed on the accompanying plans or in a Special Provision. All wood span wire poles shall be as noted in the accompanying plans.

2.38 SIGNS: All permanent traffic signing and traffic control signing shall conform to the requirements of the Manual on Uniform Traffic Control Devices. All signs shall be fabricated from standard aluminum blanks utilizing super engineer grade or high intensity grade reflective sheeting as called for the accompanying plans.

2.39 OVERHEAD STREET NAME SIGNS: Overhead street name signs shall be provided and installed on all mast arm poles. These signs shall be constructed of 0.125-inch aluminum sheeting of the size and indicated on the plans. All sign faces shall be diamond grade VIP reflective sheeting. ~~All sign legends shall be 8-inch uppercase series-C letters or numbers and shall be white in color.~~ All signs shall have a white 0.75-inch wide border and shall have green backgrounds. All signs shall have the legends centered on the face. Letter spacing shall be 100 percent and the lateral spacing to the vertical borders and spacing between words shall be 100 percent of the spacing in the outlined in the Federal Highway Administrations publications Standard Alphabets For Highway Signs. Actual sign drawings of the proposed signs shall be field located and drilled. Signs shall be mounted to the mast arms using stainless steel banding and clams using a bolt with a fiber washer. During final tightening of the bolt, the fiber washer shall be held in place so that it does not turn with the bolt. Improper tightening of the bolt will result in sign face damage.

2.40 SHOP DRAWINGS: Before commencing the installation of the Traffic signal Installation, three (3) complete sets of schedule of materials and equipment proposed for installation shall be submitted for the approval of the engineer. This schedule shall include catalog cuts, diagrams, drawings, and the engineer may require other such descriptive data as may be required by the engineer. All submittals shall include the manufacturer brand name and part number where applicable. Where more than one item is present on a submittal sheet, the appropriate item or items shall be highlighted. All submittals shall be organized as much as practical in order with the summary of quantities sheet in the plans. Three submittal packages shall be provided with one complete submittal set in each packet. In the event any items of material or equipment contained in the schedule fail to comply with specifications requirements or items are not highlighted, or submittals are not packaged, such items may be rejected. New submittals on rejected items shall be supplied to the engineer for approval. The UG and/or BPU will review all shop drawings for approval prior to submittal to KDOT. When it is required by these specifications that a test be made of the materials to be used on the work, the contractor shall furnish the Engineer a certified copy as such material. When any reference is made in these specifications to any specifications such as ASTM, IPCEA, IMSA, AIEA, AIEE, etc., or a related specification referred to by reference therein, or revision thereof which states that a certain test, or tests are to be made at the Contractors expense and three certified copies of the same be furnished as above mentioned.

2.41 Maintenance and Support

- The supplier shall maintain an adequate inventory of parts to support maintenance and repair of the system. These parts shall be available for delivery within 30 days of placement of an acceptable order at the supplier's then current pricing and terms of sale for said parts.
- The supplier shall maintain an ongoing program of technical support for the interface unit and video detection system. This technical support shall be available via telephone, or via personnel sent to the installation site upon placement of an acceptable order at the supplier's then current pricing and terms of sale for on-site technical support services.
- Installation or training support shall be provided by a factory authorized representative.
- All product documentation shall be written in the English language.

3. CONSTRUCTION REQUIREMENTS OF TRAFFIC SIGNAL SYSTEMS

3.1 SCOPE: This section governs the installation and construction of the traffic signal installation. The Contractor shall be responsible for all facets of construction whether specially mentioned or not to complete the traffic signal installation in accordance with the plans and specifications. Construction shall include but not be limited any excavation, forming, trenching, sawing, equipment installation, material placement, traffic control and project area restoration. All work shall conform to line, elevation and grades as shown on the plans or as directed by the engineer. In so much as possible, all construction shall conform to the latest accepted industry standards utilizing equipment that is appropriate for the construction task.

Whenever any parts of the plans shall be in conflict with any part or parts of the plans, or any parts of the specifications or any of the items proposed to be constructed shall appear to be impracticable, or impossible to construct, then the matter shall be immediately brought to attention of the Traffic Engineer. Her decision in the matter shall be final and the contractor shall follow her directions to avoid any such conflict in the plans or specifications.

Where the term "Traffic Engineer," is used in this section, it shall mean the Engineer in charge of construction or her duly authorized representative.

3.2 ORDER OF WORK:

3.2.1 Within twenty days following execution of a contract, the Contractor shall submit to the engineer for approval the shop drawings as required in Section 2.35 of this specification.

3.2.2 A preconstruction conference shall be held with the Contractor and the Engineer as directed by the engineer.

3.2.3 At the earliest possible time all electrical conduit, service boxes and junction boxes shall be installed at the correct grade.

3.2.4 At the earliest possible time, all pole foundations shall be installed at the correct grade.

3.2.5 The signal assembly, including signal heads, shall be erected no more than ten working days before the traffic signal installation in fully operable to perform the signal displays as set forth in this project. Traffic signal heads shall remain covered with ORANGE bags during construction until the entire installation is placed in operation. Black bags shall not be used to cover the new signal heads during construction. Traffic signal heads shall remain covered during construction until the entire installation is placed in operation. Signal heads are to be covered to convey to drivers that they are not operational, as approved by the engineer.

3.2.6 The induction loops may be installed at any time, provided they have been in place for at least three weeks prior to final contract acceptance.

3.2.7 The contractor is hereby advised that the work to be done shall be completed with full knowledge of the schedule made available to the engineer. The Traffic Engineer may, at her option, cause work completed without his knowledge or inspection, to be dismantled and inspected.

3.2.8 Any requested the engineer or her representatives must approve deviation from the "Order of Work" established herein must be approved by the engineer or his representatives.

3.2.9 Locating of Utilities

In addition to the above and prior to any construction, The contractor shall be responsible for locating all utilities whether above, on, or below the ground and to protect the city against any and all damages arising from the contractors failure to have utilities located and exercise due care when working near utilities. The contractor is notified that all existing utility information, including any existing traffic signal equipment locations, were obtained from existing office record and that prior to any excavation, the Contractor shall have all locations verified in the field by the respective utility companies.

No new fixture shall be constructed as part of this contract which is in contact with any existing utility facility, or the code required thereby, unless approved by the engineer.

3.2.10 Notification of Property Owners

The contractor shall notify each property owner at least one day in advance of construction activity being started in front of the respective property.

3.2.11 Contractor Requirements

The contractor shall have a copy of the plans and specifications at the job location at all times. All traffic signal installation work shall be done by, or in the presence of and under responsible charge of an employee of the Contractor who holds a Level II Traffic Signal Electrician or Level II Traffic Signal Technician certification which has been granted by International Municipal Signal Association.

3.2.12 Traffic Control

Traffic Control for this work shall confirm with the requirements of Section 1300 of the Technical Provisions & Standard Drawings, with the Manual on Uniform Traffic Control Devices (MUTCD) and with the requirements of the Plans. No deviation from these standards is allowed without written permission of the Engineer.

3.3 CONSTRUCTION REQUIREMENTS

3.3.1 Service Boxes:

Service boxes shall be installed as shown on the plans and on the Standard Detail sheets and at such additional points at the Contractor, at his own expense and with the approval of the Traffic Engineer, may desire to facilitate work. Unless otherwise directed by the Traffic Engineer, all service boxes shall be installed level to 1 inch above the finish grade.

3.3.1.1 CMP Service Boxes:

CMP service boxes shall be installed at the location shown on the plans and as shown on the Traffic Signal Detail sheets and as such point as the Contractor, at his own expense, may desire to facilitate the work. An 8-inch layer of aggregate shall be provided under all service and junction boxes for drainage as shown on the Traffic Signal Detail sheets in the plans. Unless otherwise directed by the Traffic Engineer, all service and junction boxes shall be installed level to 1 inch above the finish grade. After conduits are inserted into the service boxes, the extra space around the conduits is to be filled with spray foam to prohibit infiltration of water or soil.

3.3.1.2 Polymer Concrete Composite Service Boxes:

Polymer Concrete Composite service boxes shall be installed at the location show on the plans and as shown on the Traffic Signal Detail sheets. An 8-inch layer of aggregate shall be provided under all service boxes for drainage as shown on the Traffic Signal Detail sheets in the plans. Due to the size of these boxes and the need to make them ADA compatible, the contractor shall stake all four corners of the boxes. Boxes shall not be installed until the profile and pitch of these boxes is approved by the Traffic Engineer.

Polymer Concrete Composite Service Boxes shall be installer prior to installation of conduits. Slotting of these boxes for the purpose of accommodating conduit is prohibited in order to maintain the structural integrity of the boxes and to keep soil from infiltrating the box. Holes for conduits shall be core drilled into the sides of the boxes as approved by the engineer.

Holes for conduits for mainline optical fiber are to be aligned in such a manner as to allow the conduit to be installed through the box and 20 feet beyond as shown on the standard drawings. The conduit inside the service box will not be removed until fiber is ready to be installed. When long-line conduit is installed, the through-box conduit will be placed such that it can be fusion coupled to the long-line conduit. Mainline optical fiber conduit shall enter service boxes 18-inches below the top of the box.

After conduits are inserted into the service boxes, the extra space around the conduits is to be filled with spray foam to prohibit infiltration of water or soil.

3.3.1 Conduit:

Conduit shall be installed as shown in the plans and Traffic Signal Detail sheets and in conformance with appropriate articles of the National Electric Code. The size of the conduit shall be as shown on the plans. It shall be the privilege of the Contractor, at his own expense, to use larger size conduit if desired; and where larger size conduit is used. It shall be for the entire length of the run from outlet to outlet. No reducing couplings will be permitted.

Conduit for optical fiber shall be bored at a depth of 48 inches below final grade of the ground, street, driveway, or sidewalk it is placed under. This conduit shall maintain a constant 48-inch depth. This will be proved by installing and toning a trace wire. This conduit is intended for long run backhaul fiber that will be used by BPU and the UG. BPU will be installing high count fiber in this conduit at a later date.

Conduits shall be kept clean during the installation process. In the event the contractor allows soil or boring sludge to contaminate the inside of the conduit, the Engineer will determine whether the conduit will be completely cleaned or replaced. Conduit must maintain the lubricated condition it was provided in for the purpose of installing fabric inner-duct and/or multiple optical fiber runs that will be installed independently over time.

Subsidiary to conduit installation and conditional for payment for conduit work is the installation of nylon pull rope in conduits for metallic cable and mule tape along with trace wire in conduits intended for optical fiber cable. Even if the project includes installation of cable the pull rope, mule tape, and trace wire must be installed and approved prior to cable installation. Contractor shall demonstrate to the Engineer the ability of pull rope and mule tape to move readily. Trace wire must have continuity and will be used to prove the depth of installation of conduit for optical fiber.

3.3.2 Excavations

The Contractor shall perform all excavations for installation underground conduits, cable, boxes, and pole based in whatever substances encountered, to the depths indicated on the drawings or as otherwise approved. During excavation, material suitable for backfilling shall be piled in an orderly manner a sufficient distance from the excavation to avoid slides. Excavated materials shall be kept off sidewalks and out of the street where possible. Excavated material that is piled on sidewalks or in streets shall be removed by the end of the same working day. The Contractor shall pile excavated materials such that drivers' visibility will not be obstructed. All excavated materials not required or unsuitable for backfill shall be removed and wasted on a site obtained by the Contractor. Excavations and trenches shall not be larger or wider than necessary for the proper installation of foundations or electrical appliance. Excavation shall not be performed until immediately before the installation of conduit, bases, or other appliances. All excess excavated material shall be removed at the earliest possible time or as directed by the Engineer.

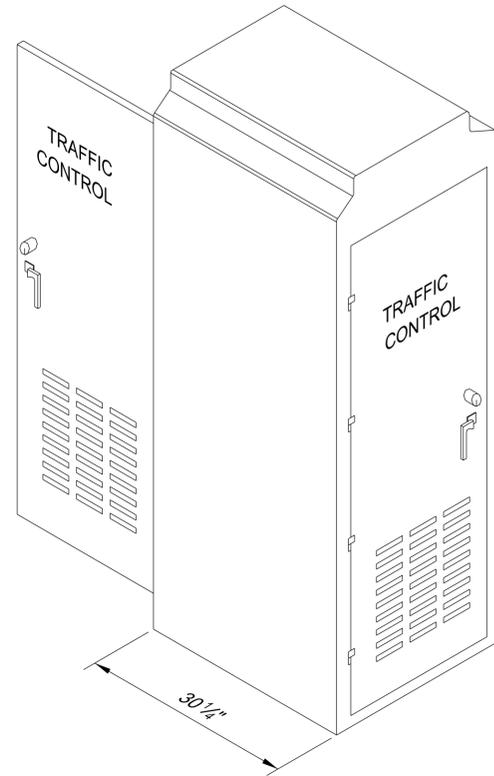
3.3.2 Backfill & Compaction

All areas excavated shall be backfilled and compacted in accordance with these Specifications. Backfill shall be deposited in not over 6" layers and tamped to 95 percent density +/- 3 percent of optimum moisture. The top 6 inches of backfill shall be select soil suitable for sodding. All areas excavated shall be backfilled at the earliest possible time or as directed by the Engineer. After backfilling, all disturbed area shall be kept well filled and maintained in a smooth and well drained condition until permanent repairs are made. Where trenches are excavated in established sod areas, the area shall be backfilled the same day excavation occurs by a method approved by the Engineer. Approved methods are intended to reduce damage to the established sod area.

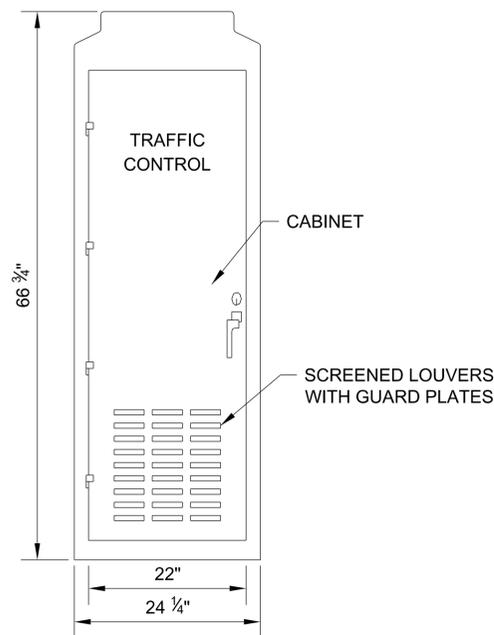
				BY	TRAFFIC SIGNAL SPECIFICATIONS SHEET 8 OF 9 CITY OF KANSAS CITY, KANSAS PUBLIC WORKS DEPARTMENT TRAFFIC DIVISION			
				REVISIONS				
				DATE	DESIGNED: KCK	DRAWN: B&McD		
					CHECKED: B&McD	DATE: 3/20/2017		
					SCALE: N/A	SHEET NO.:		

TYPE 170 CABINET DETAILS

(TYPE 332)

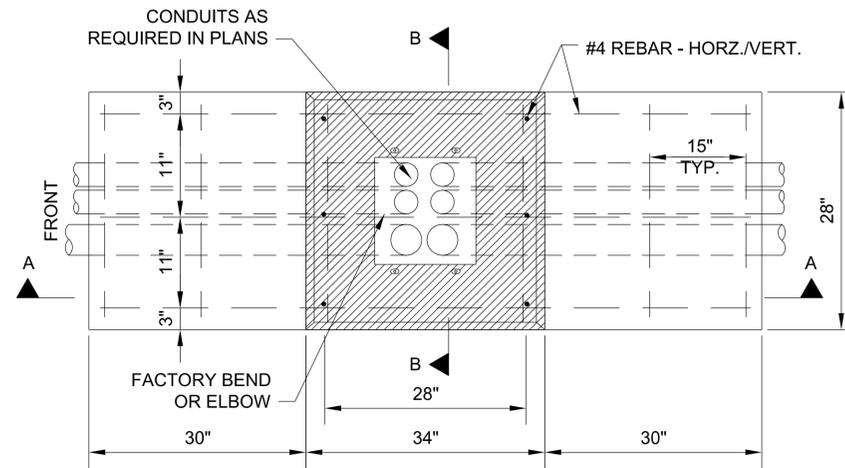


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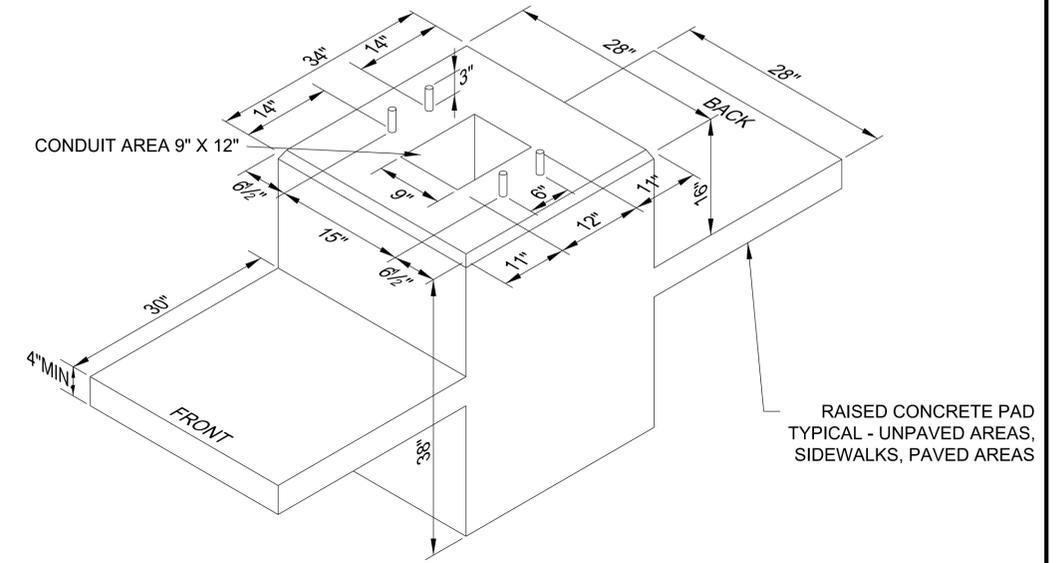


ELEVATION

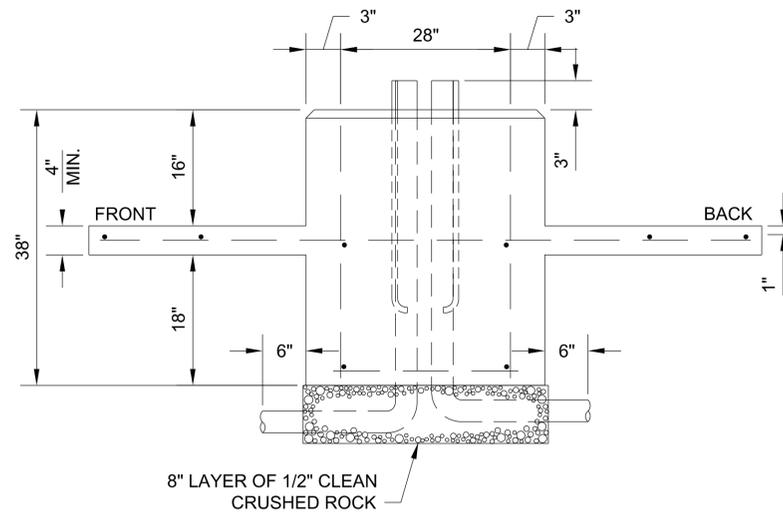
TYPE 170 SINGLE CABINET PAD BASE



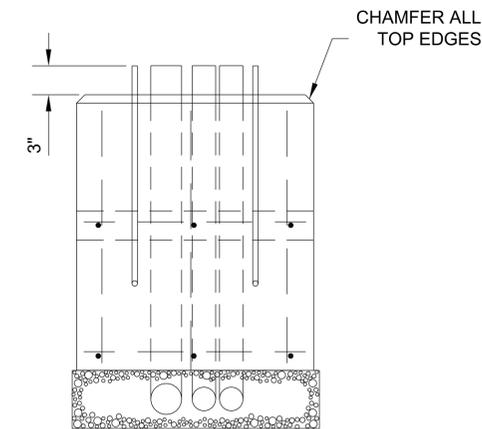
PLAN



ISOMETRIC



ELEVATION A-A



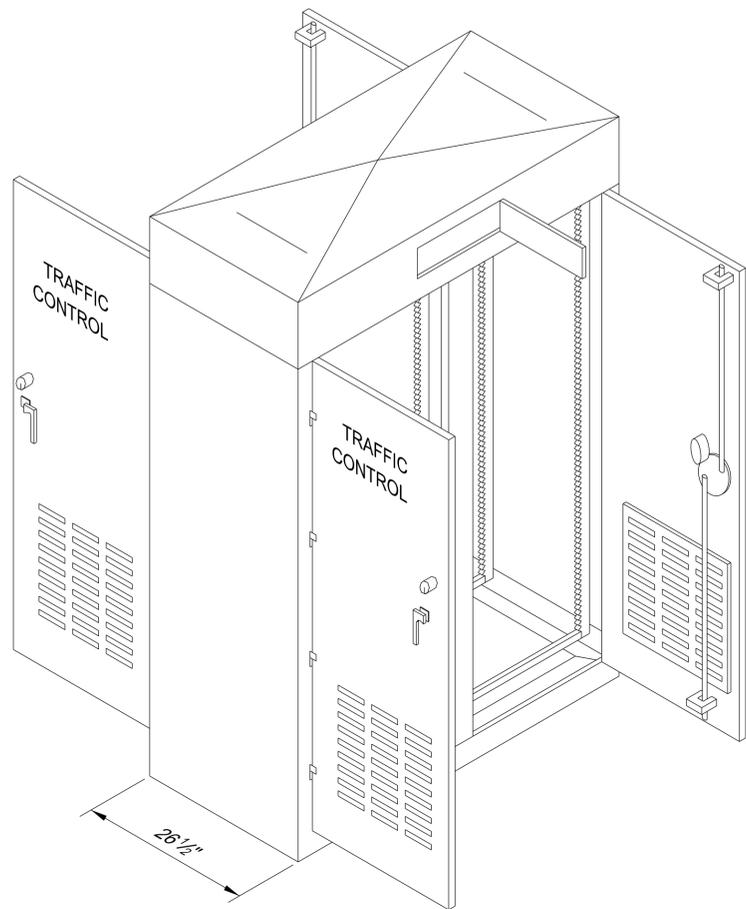
SECTION B-B

ITS CABINET PAD NOTES:

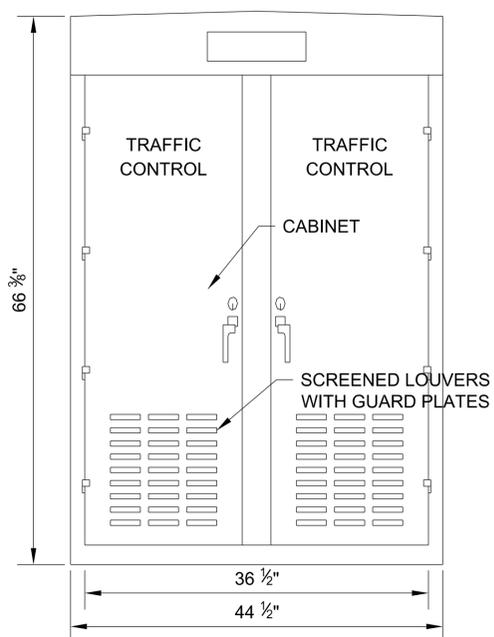
1. ALL CONDUITS SHALL BE RIGIDLY INSTALLED BEFORE CONCRETE IS PLACED.
2. TOP OF PAD TO BE SLOPED TO DRAIN.
3. A 1-c#6 SOLID COPPER SYSTEM GROUND CABLE SHALL BE INSTALLED THROUGH ONE OF THE PVC CONDUITS BETWEEN THE CONTROLLER AND CLOSEST SERVICE BOX.
4. DUCT SEAL SHALL BE APPLIED AT ALL CONDUIT ENTRANCES AFTER CABLE INSTALLATION.
5. A WATERTIGHT SEAL SHALL BE APPLIED ALONG THE INSIDE AND OUTSIDE EDGES OF THE CABINET WHERE IT ABUTS TO THE CONCRETE PAD.

REVISIONS		DATE		<p align="center">ITS SYSTEM DETAILS 1 OF 5 TYPE 170 CABINET AND SINGLE CABINET BASE DETAILS CITY OF KANSAS CITY, KANSAS PUBLIC WORKS DEPARTMENT TRAFFIC DIVISION</p> 	
DESIGNED:	GBA	DRAWN:	GBA	CHECKED:	KCK
DATE:	4/27/2016	SCALE:	N/A	DATE:	5/22/08
GENERAL DRAWINGS UPDATE			SHEET NO.:		

TYPE 170 DOUBLE WIDE CABINET

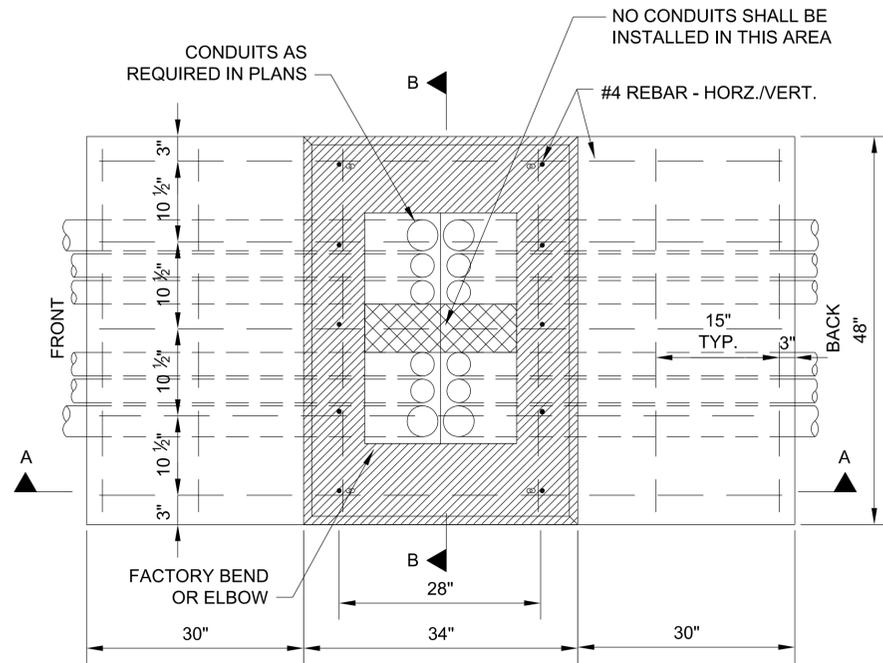


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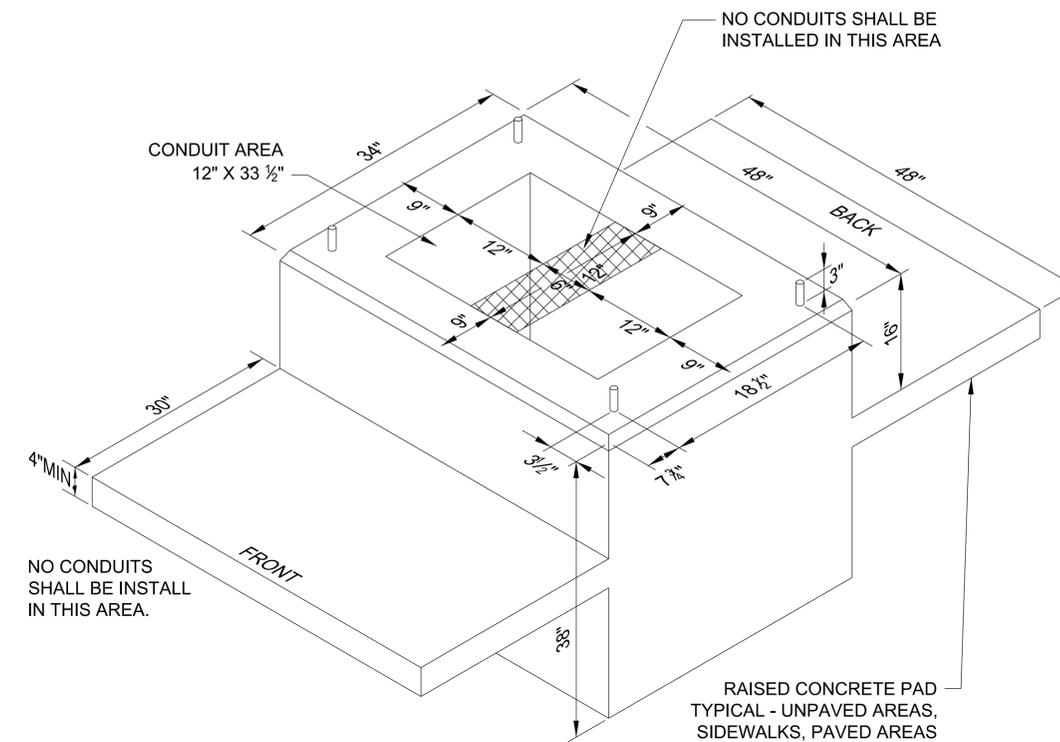


ELEVATION

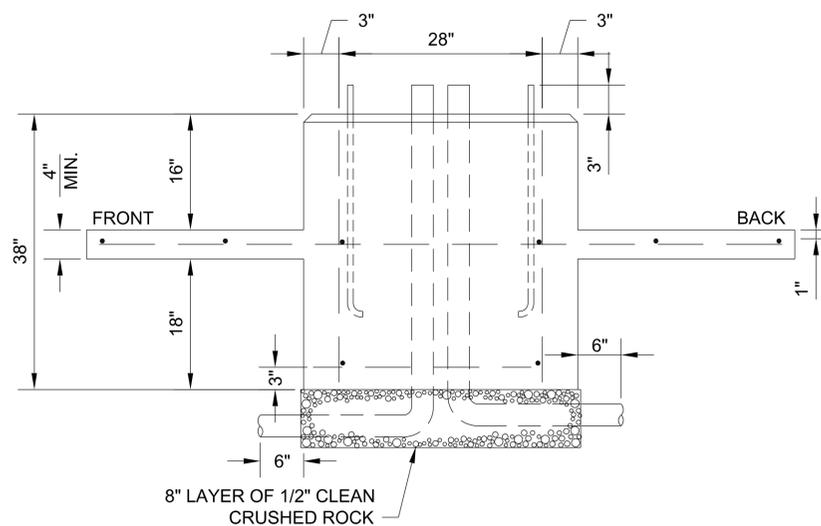
TYPE 170 DOUBLE WIDE CABINET BASE



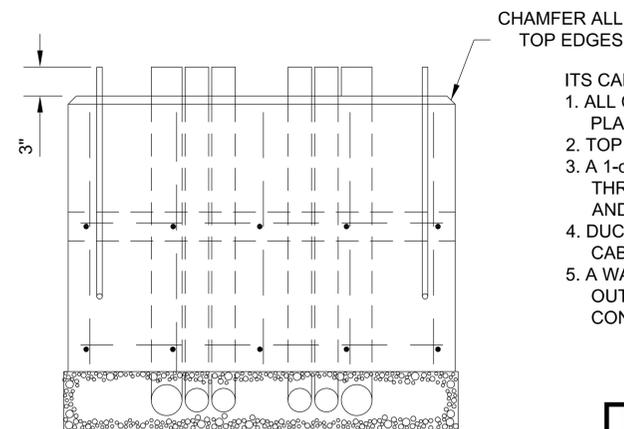
PLAN



ISOMETRIC



ELEVATION A-A

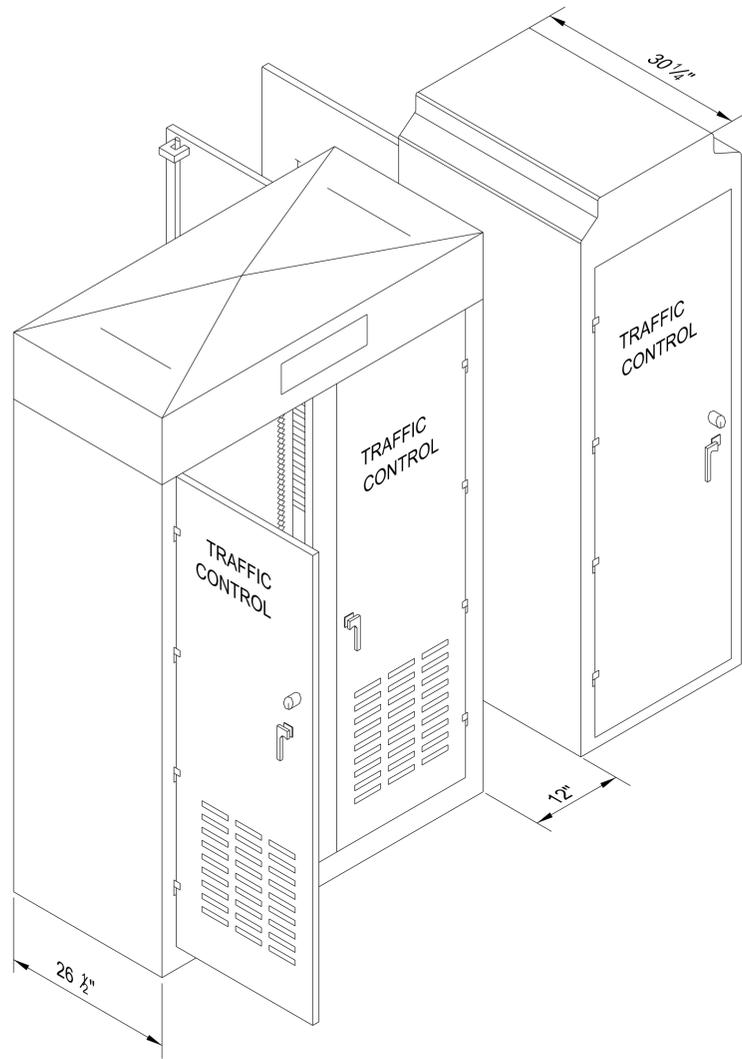


SECTION B-B

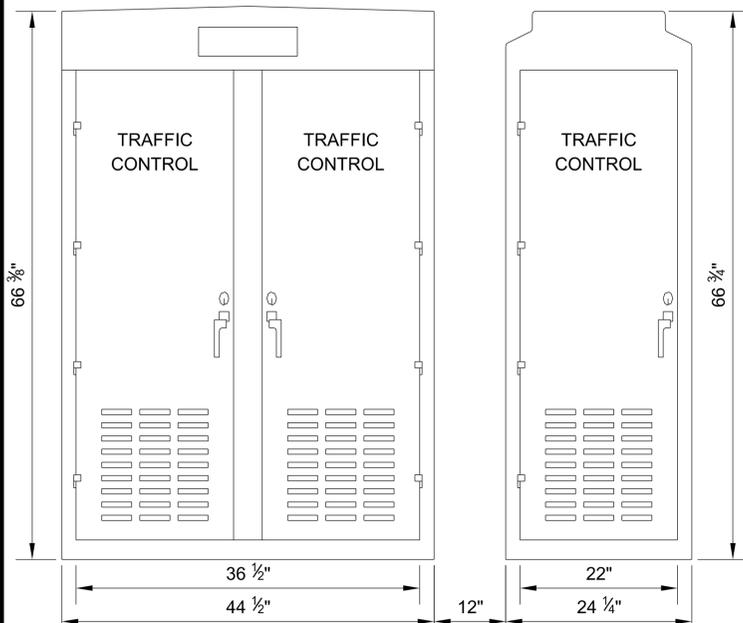
- ITS CABINET PAD NOTES:
1. ALL CONDUITS SHALL BE RIGIDLY INSTALLED BEFORE CONCRETE IS PLACED.
 2. TOP OF PAD TO BE SLOPED TO DRAIN.
 3. A 1-c#6 SOLID COPPER SYSTEM GROUND CABLE SHALL BE INSTALLED THROUGH ONE OF THE PVC CONDUITS BETWEEN THE CONTROLLER AND CLOSEST SERVICE BOX.
 4. DUCT SEAL SHALL BE APPLIED AT ALL CONDUIT ENTRANCES AFTER CABLE INSTALLATION.
 5. A WATERTIGHT SEAL SHALL BE APPLIED ALONG THE INSIDE AND OUTSIDE EDGES OF THE CABINET WHERE IT ABUTS TO THE CONCRETE PAD.

DATE		4/27/2016		GENERAL DRAWING UPDATE		REVISIONS		BY		REVISIONS	
<p align="center">ITS SYSTEM DETAILS 2 OF 5 TYPE 170 DOUBLE WIDE CABINET AND BASE DETAILS CITY OF KANSAS CITY, KANSAS PUBLIC WORKS DEPARTMENT TRAFFIC DIVISION</p>											
DESIGNED:		GBA		DRAWN:		GBA		CHECKED:		KCK	
SCALE:		N/A		DATE:		5/22/08		SHEET NO.:			

TYPE 170 DOUBLE WIDE +1 CABINET

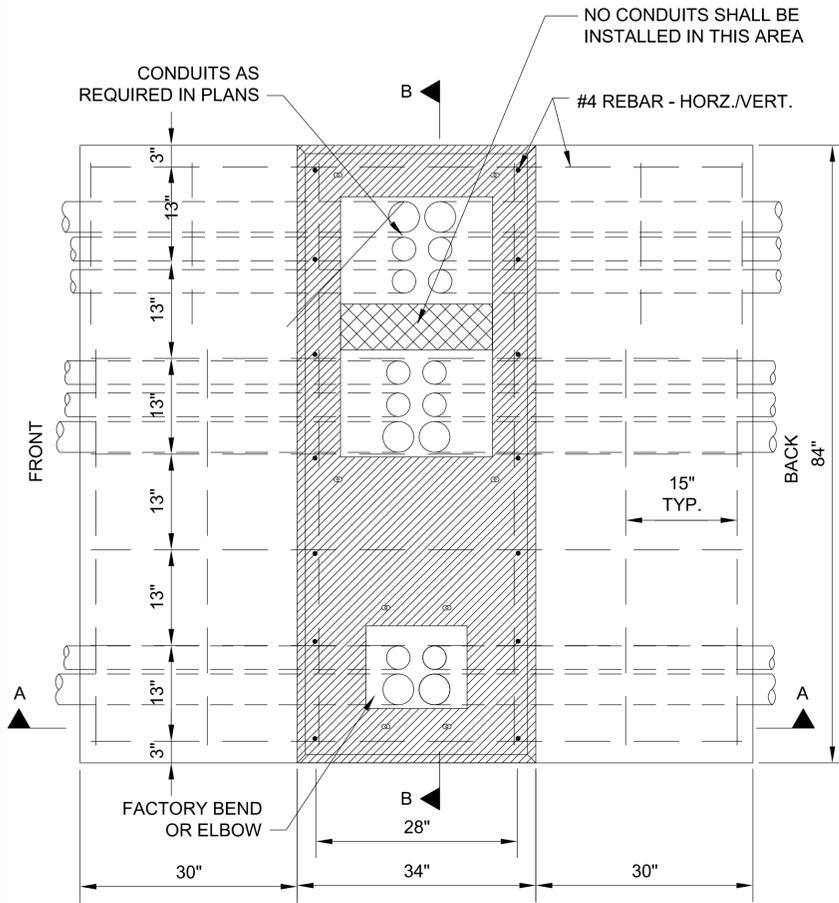


ISOMETRIC

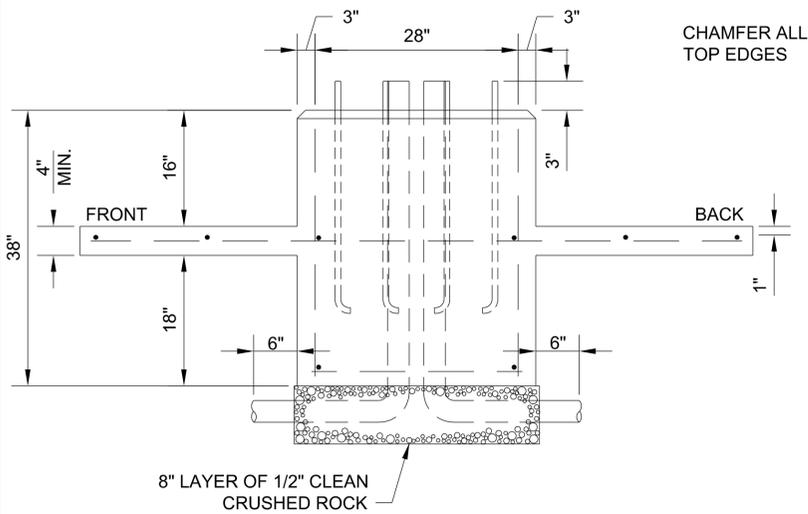


ELEVATION

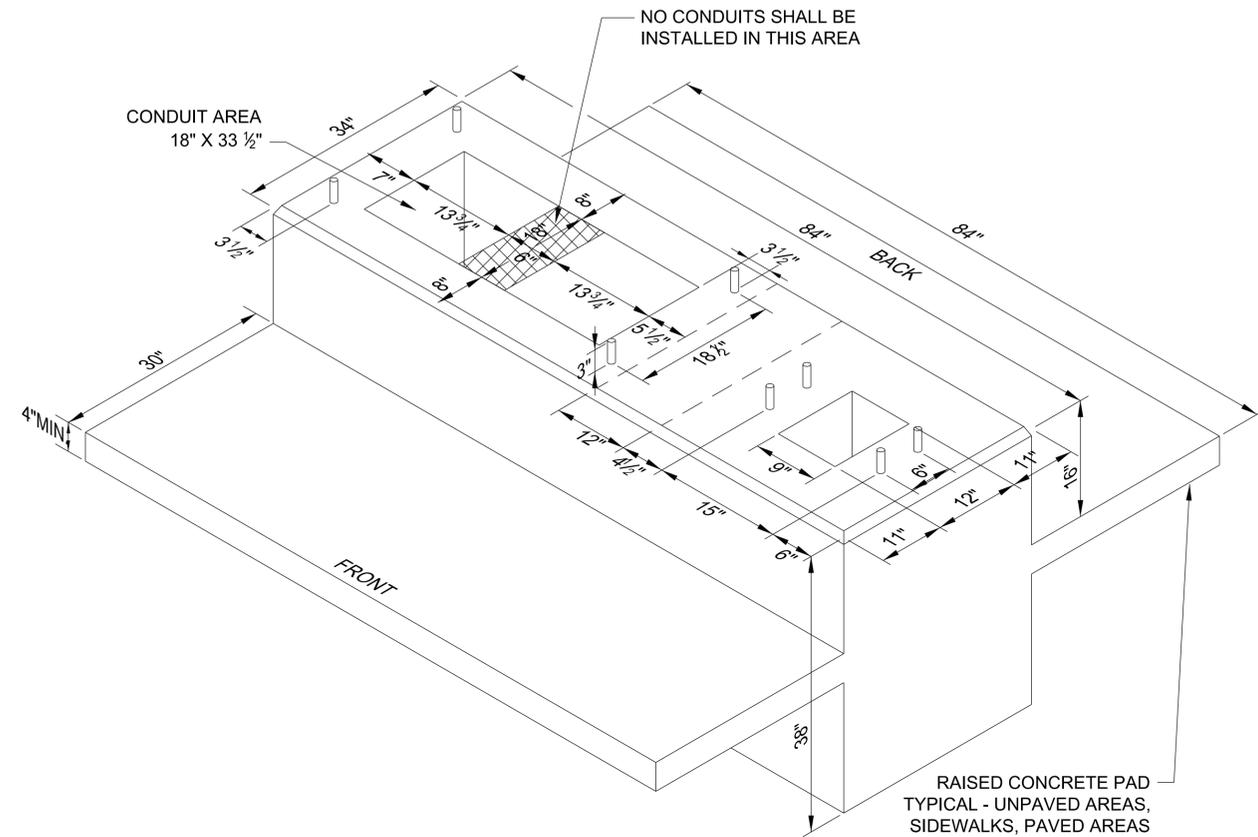
TYPE 170 DOUBLE WIDE +1 CABINET BASE



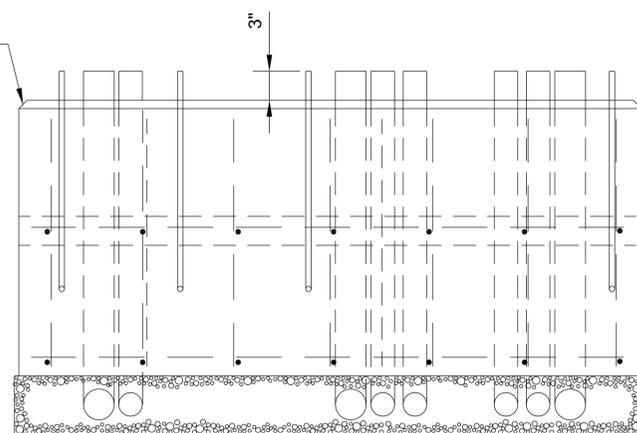
PLAN



ELEVATION A-A



ISOMETRIC



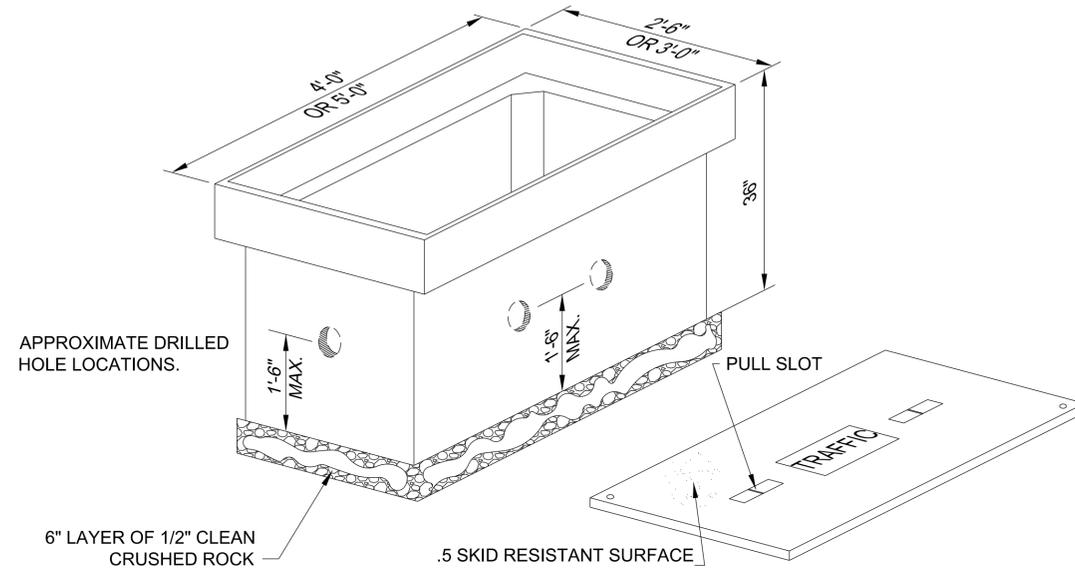
SECTION B-B

* THIS DETAIL IS FOR TWO DISTINCT CABINETS. EACH SHALL HAVE SEPARATE GROUNDING PROVIDED THROUGH ITS PVC CONDUIT TO ITS NEAREST SERVICE BOX.

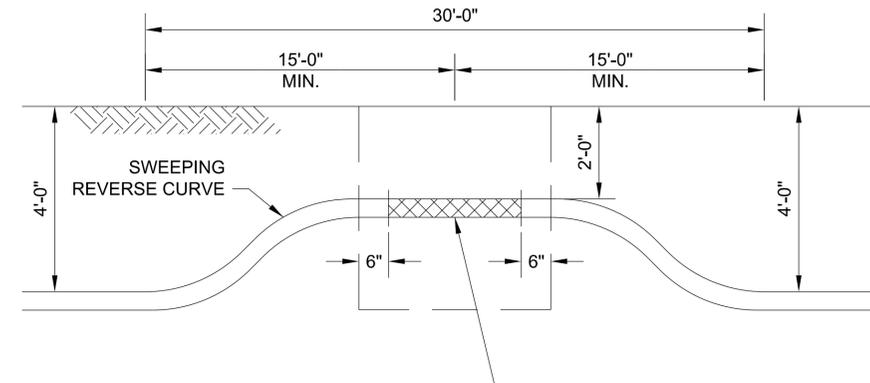
- ITS CABINET PAD NOTES:
1. ALL CONDUITS SHALL BE RIGIDLY INSTALLED BEFORE CONCRETE IS PLACED.
 2. TOP OF PAD TO BE SLOPED TO DRAIN.
 3. TWO 1-#6 SOLID COPPER SYSTEM GROUND CABLES SHALL BE INSTALLED THROUGH ONE OF THE PVC CONDUITS BETWEEN THE CABINET AND CLOSEST SERVICE BOX FOR BOTH THE CONTROLLER AND COMMUNICATIONS SIDES OF THE CABINET.
 4. DUCT SEAL SHALL BE APPLIED AT ALL CONDUIT ENTRANCES AFTER CABLE INSTALLATION.
 5. A WATERTIGHT SEAL SHALL BE APPLIED ALONG THE INSIDE AND OUTSIDE EDGES OF THE CABINET WHERE IT ABUTS TO THE CONCRETE PAD.

<p align="center">ITS SYSTEM DETAILS 4 OF 5 TYPE 170 DOUBLE WIDE + 1 CABINET AND BASE DETAILS CITY OF KANSAS CITY, KANSAS PUBLIC WORKS DEPARTMENT TRAFFIC DIVISION</p>	
<p>DESIGNED: GBA CHECKED: KCK SCALE: N/A</p>	<p>DRAWN: GBA DATE: 5/22/08 SHEET NO.:</p>

ITS SERVICE BOX DETAIL



ISOMETRIC



SECTION

NOTES:

1. ITS SERVICE BOXES SHALL BE ARMORCAST BRAND 30" X 48" OR 36" X 60" POLYMER COMPOSITES, STACKABLE FOR VARYING DEPTHS, RATED FOR 20,000 LBS. LOADING, AND WITH HEAVY DUTY COVERS MEETING DESIGN LOADS OF 22,500 LBS. MINIMUM. BOXES SHALL NOT HAVE BOTTOMS.
2. BOXES ARE NOT TO BE SLOTTED FOR PLACEMENT OVER EXISTING CONDUITS.
3. CONDUITS SHALL NOT BE ELBOWED UP FOR ENTRY THROUGH BOX BOTTOM.
4. ALL INTERCONNECT CONDUITS SHALL BE HDPE SDR 11, BLACK WITH THREE RED STRIPES.
5. AN 6 INCH THICK LAYER OF 1/2 INCH AGGREGATE SHALL BE PROVIDED UNDER ALL SERVICE BOXES

CONSTRUCTION PROCEDURE FOR OPTICAL FIBER SERVICE BOXES:

1. BOX SHALL BE SET TO LINE AND GRADE.
2. 20 FT LONG PIECES OF CONDUIT SHALL BE INSERTED THROUGH DRILLED HOLES TO FACILITATE FIBER PULLING. CENTER OF CONDUIT PIECES SHALL BE IN CENTER OF BOX.
3. CUT CONDUIT AT CENTER OF BOX AND PULL CONDUIT BACK OR REMOVE MIDDLE PORTION LEAVING 6" OF CONDUIT REMAINING IN THE BOX FOR BOTH ENDS OF CONDUIT. CONDUIT FROM BOX SHALL BE FUSION SPLICED TO MAIN LINE CONDUIT.
4. FIBER CONDUIT SHALL BE 24" DEEP AT THE BOX. FIBER OPTIC CONDUIT SHALL BE 48" DEEP BETWEEN BOXES.
5. FIBER CONDUIT MAY BE FUSION SPLICED TO MAIN LINE FIBER OPTIC CONDUIT, WHERE REQUIRED, A MINIMUM OF 10 FEET AWAY FROM CENTER OF BOX.
6. FIBER CONDUIT HOLES SHALL BE SEALED ON INSIDE AND OUTSIDE OF BOX.

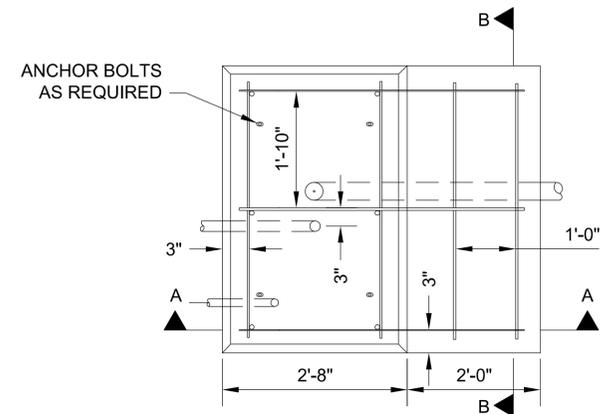
ITS SYSTEM DETAILS 5 OF 5	
SERVICE BOX DETAILS	
CITY OF KANSAS CITY, KANSAS	
PUBLIC WORKS DEPARTMENT	
TRAFFIC DIVISION	
DESIGNED: GBA	DRAWN: GBA
CHECKED: KCK	DATE: 5/22/08
SCALE: N/A	SHEET NO.:



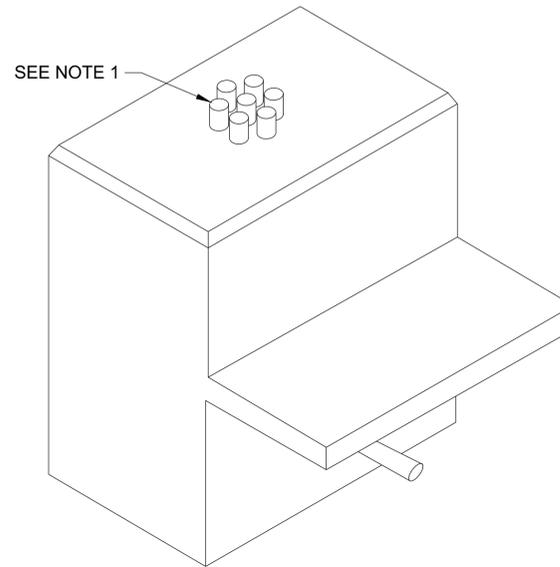
CONTROLLER PAD TYPE "P" OR "R" DETAILS

NOTES:

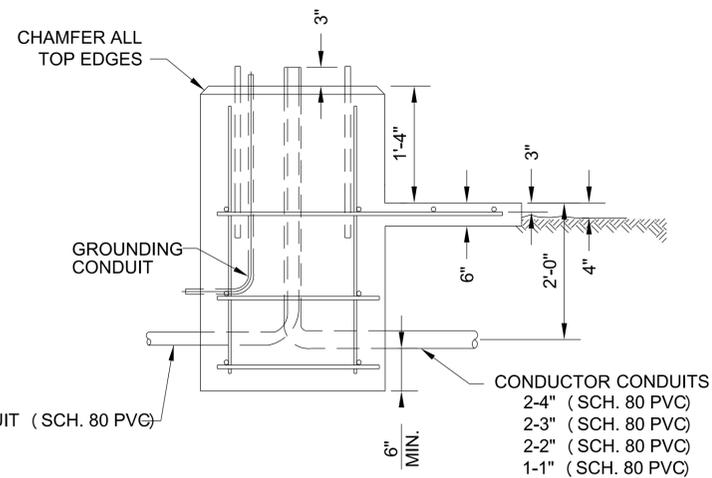
- 1) TYPICAL CABINET PAD INSTALLATIONS WILL HAVE 2-4", 2-3", 2-2", AND 1-1" SCH. 80 PVC CONDUITS RUNNING TO CABINET SERVICE BOX.
- 2) CONCRETE FOR PAD SHALL BE COMMERCIAL GRADE.



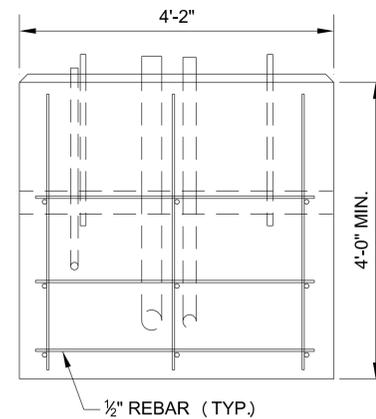
PLAN



ISOMETRIC

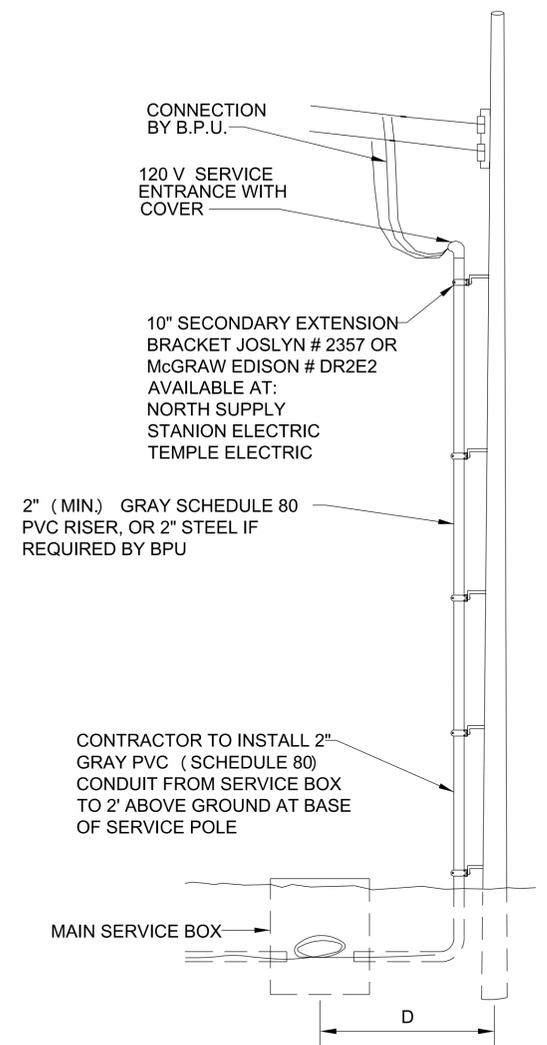


ELEVATION A/A



ELEVATION B/B

SECONDARY SERVICE DETAIL



2 URD DUPLEX OR TRIPLEX CABLE WILL BE INSTALLED FROM TRANSFORMER TO MAIN SERVICE BOX. CONTRACTOR IS RESPONSIBLE FOR INSTALLING POWER SERVICE CONDUIT AND CABLE FROM MAIN SERVICE BOX TO AND UP POLE INCLUDING RISER, STANDOFFS, ENTRANCE HEAD, AND ELECTRICAL ENCLOSURE (IF APPLICABLE). CONTRACTOR TO LEAVE POWER CABLE UNCONNECTED AT ENTRANCE HEAD, BPU WILL COMPLETE CABLE HOOK-UP. CONTRACTOR TO COORDINATE RISER HEIGHT AND QUANTITY OF EXCESS CABLE AT ENTRANCE HEAD WITH BPU.

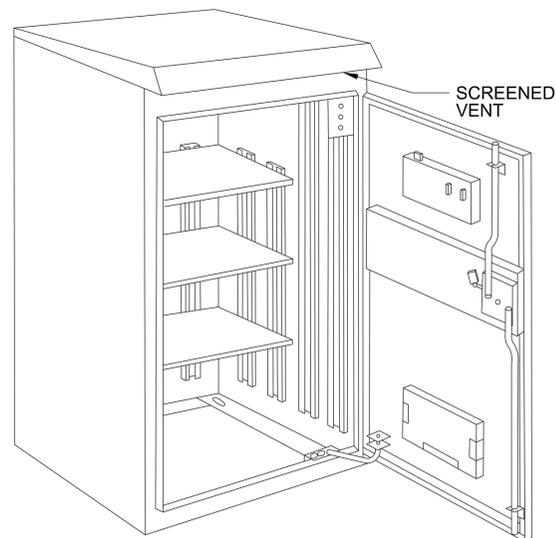
NO.	DATE	REVISIONS	BY

TRAFFIC SIGNAL DETAILS 1 OF 12
NEMA TYPE P AND R CONTROLLER
BASE AND POWER DETAILS
CITY OF KANSAS CITY, KANSAS
PUBLIC WORKS DEPARTMENT
TRAFFIC DIVISION

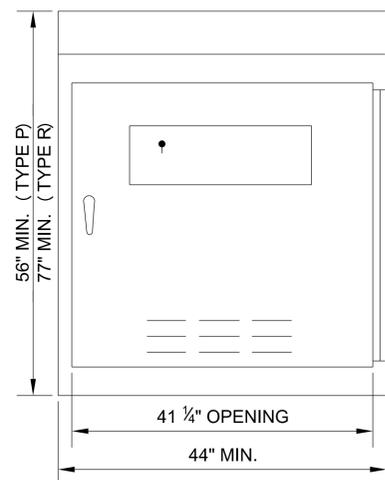
DESIGNED: GBA	DRAWN: GBA
CHECKED: KCK	DATE: 3/20/2017
SCALE: N/A	SHEET NO.:

CONTROLLER CABINET, TYPES "P" AND "R"

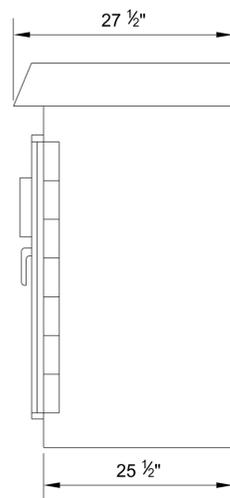
(TYPE P CABINET TO BE SUPPLIED WITH 3 SHELVES,
TYPE R CABINET TO BE SUPPLIED WITH 4 SHELVES)



ISOMETRIC



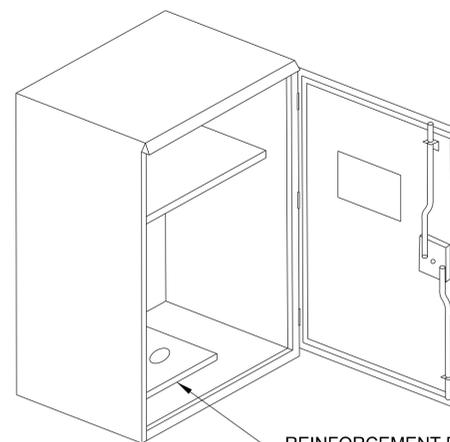
ELEVATION



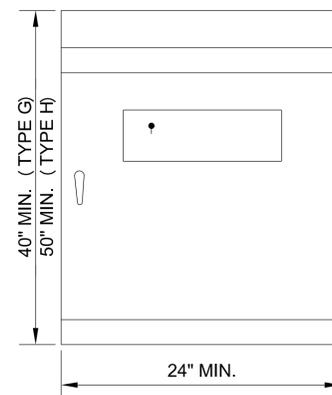
SECTION

CONTROLLER CABINET, TYPES "G" AND "H"

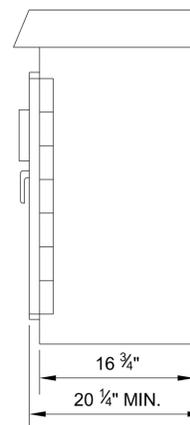
(POLE MOUNTED)



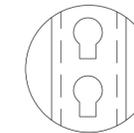
ISOMETRIC



ELEVATION



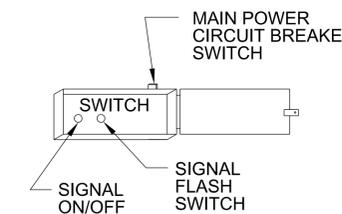
SECTION



OPTIONAL SHELF MOUNT



STANDARD SHELF MOUNT



NOTES:

1. THE CONTROLLER CABINET FINISH SHALL BE NATURAL ALUMINUM.
2. THE MATERIAL SHALL BE 0.125" THICK ALUMINUM.
3. POLE ATTACHMENT HARDWARE FOR TWO-POINT ATTACHMENT SHALL BE PROVIDED FOR CONTROLLER CABINET TYPES G AND H.
4. HYBRID CABINETS SHALL NOT BE ACCEPTED.

BY **TRAFFIC SIGNAL DETAILS 2 OF 12**
CONTROLLER CABINET DETAILS

REVISIONS **CITY OF KANSAS CITY, KANSAS**
PUBLIC WORKS DEPARTMENT
TRAFFIC DIVISION

DESIGNED: **GBA** DRAWN: **GBA**
CHECKED: **KCK** DATE: **3/20/2017**
SCALE: **N/A** SHEET NO.:

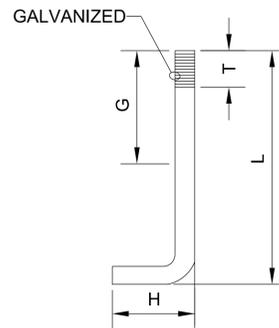
DATE

MAST ARM LENGTH	BOLT SIZE	L	H	T	G
20' OR LESS	1½" X 60"	54"	6"	8"	12"
22' - 26'	1½" X 60"	54"	6"	8"	12"
28' - 36'	1¾" X 90"	84"	6"	8"	12"
38' - 48'	1¾" X 90"	84"	6"	8"	12"
50' - 55'	1¾" X 90"	84"	6"	8"	12"
60' - 65'	1¾" X 90"	84"	6"	8"	12"

MAST ARM POLE ANCHOR BOLT SCHEDULE

BOLT SIZE	L	H	T	G
¾" X 18"	15"	3"	6"	12"

PEDESTAL POLE ANCHOR BOLT SCHEDULE



MAST ARM LENGTH	FOOTING DIAMETER	DEPTH	"V" BARS	"S" BARS	BOLT CIRCLE (Y)
20' OR LESS	36"	9'-6"	7-#8 BARS X 9'-0"	10-#5 BARS @ 12" MAX.	16"
22' - 26'	36"	11'-0"	7-#8 BARS X 10'-6"	12-#5 BARS @ 12" MAX.	16½"
28' - 36'	36"	12'-6"	7-#8 BARS X 12'-0"	13-#5 BARS @ 12" MAX.	17½"
38' - 48'	36"	13'-0"	8-#8 BARS X 12'-6"	14-#5 BARS @ 12" MAX.	18"
50' - 55'	36"	15'-0"	8-#8 BARS X 14'-6"	16-#5 BARS @ 12" MAX.	20"
60' - 65'	36"	15'-0"	8-#8 BARS X 14'-6"	16-#5 BARS @ 12" MAX.	21"
#					

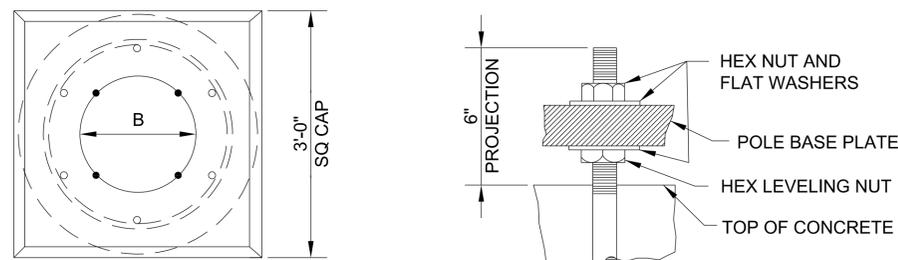
A structural analysis shall be done for mast arms lengths exceeding 65'.

MAST ARM POLE AND BASE SCHEDULE

POST	FOOTING DIAMETER	DEPTH	"V" BARS	"S" BARS	BOLT CIRCLE (B)
4 ½"	24"	3'-6"	6-#4 BARS X 3'-0"	2-#4 BARS @ 12" MAX.	12¾"

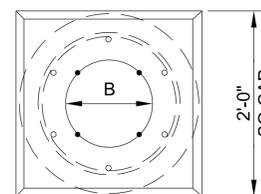
PEDESTAL POLE BASE SCHEDULE

MAST ARM POLE BASE



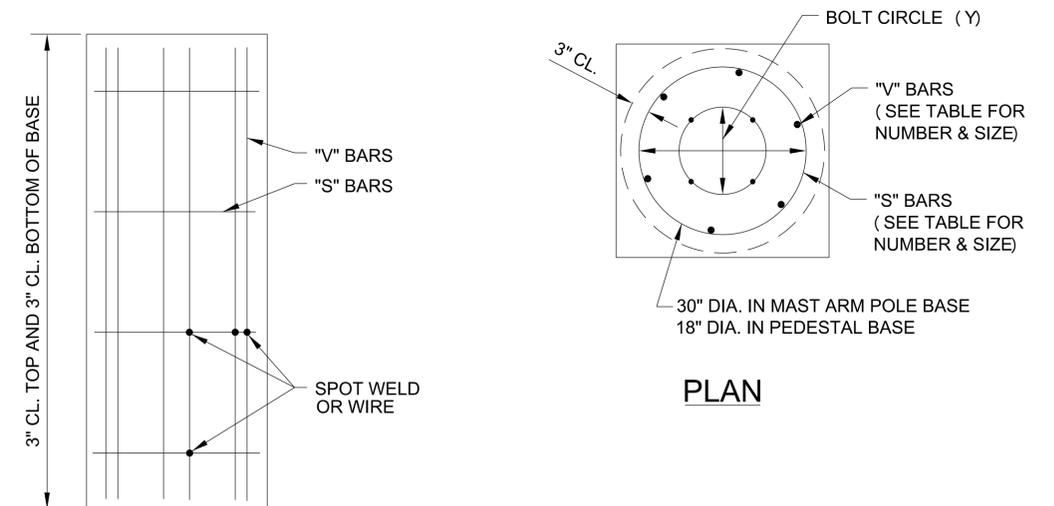
PLAN

PEDESTAL BASE



PLAN

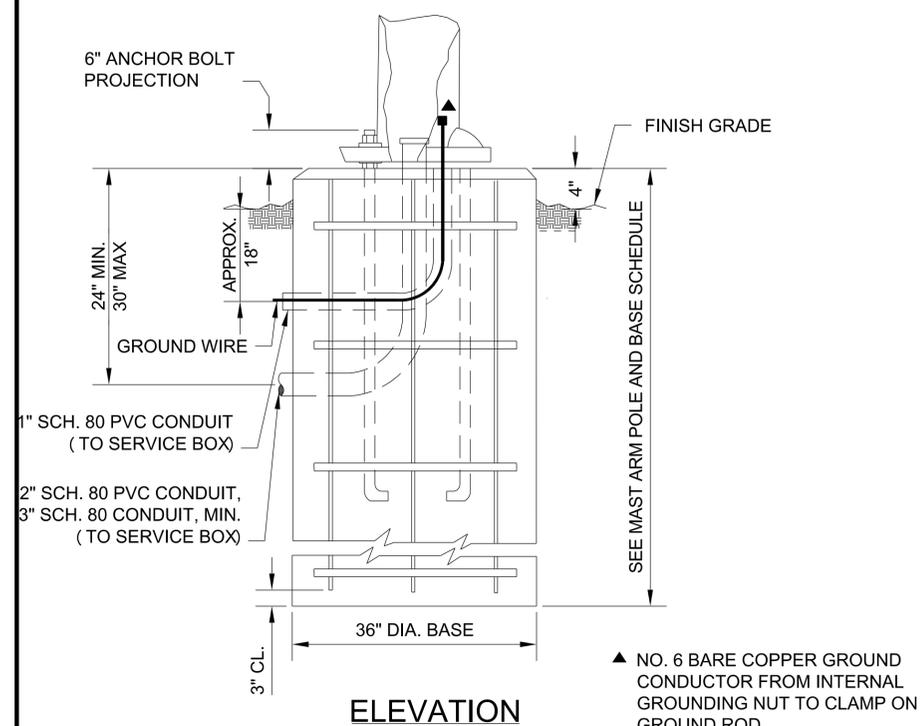
REBAR CAGE DETAILS



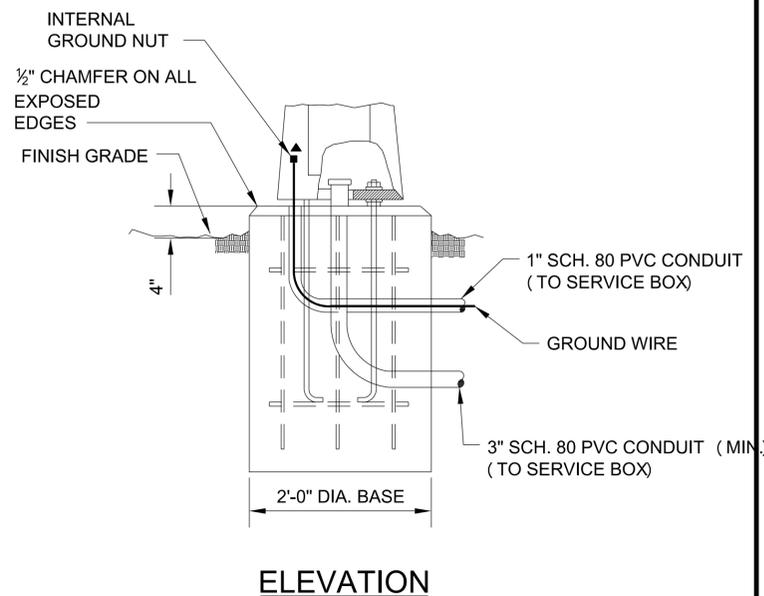
PLAN

ELEVATION

NOTE:
CONCRETE FOR BASES
SHALL BE COMMERCIAL
GRADE.



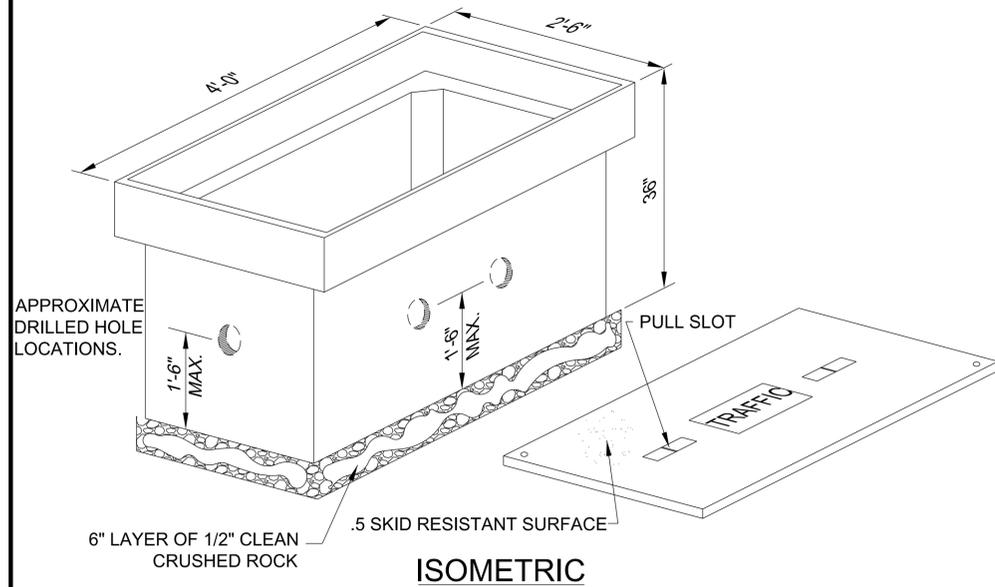
ELEVATION



ELEVATION

REVISIONS		TRAFFIC SIGNAL DETAILS 3 OF 12	
DATE	BY	CONCRETE FOOTING DETAILS	
		CITY OF KANSAS CITY, KANSAS PUBLIC WORKS DEPARTMENT TRAFFIC DIVISION	
DESIGNED:	GBA	DRAWN:	GBA
CHECKED:	KCK	DATE:	3/20/2017
SCALE:	N/A	SHEET NO.:	

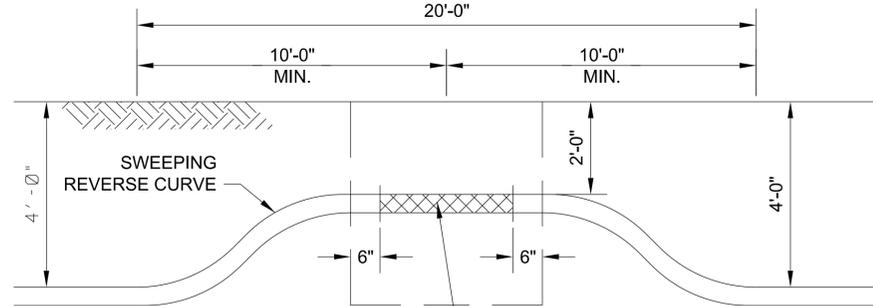
CABINET SERVICE BOX AND OPTICAL FIBER BOX DETAIL



ISOMETRIC

NOTES:

1. CABINET SERVICE BOXES AND INTERCONNECT SERVICE BOXES SHALL BE ARMORCAST BRAND 30" X 48" POLYMER COMPOSITES, STACKABLE FOR VARYING DEPTHS, RATED FOR 20,000 LBS. LOADING, AND WITH HEAVY DUTY COVERS MEETING DESIGN LOADS OF 22,500 LBS. MINIMUM. BOXES SHALL NOT HAVE BOTTOMS.
2. BOXES ARE NOT TO BE SLOTTED FOR PLACEMENT OVER EXISTING CONDUITS.
3. CONDUITS SHALL NOT BE ELBOWED UP FOR ENTRY THROUGH BOX BOTTOM.
4. ALL INTERCONNECT CONDUITS SHALL BE HDPE SDR 11, BLACK WITH THREE RED STRIPES.
5. AN 6 INCH THICK LAYER OF 1/2 INCH AGGREGATE SHALL BE PROVIDED UNDER ALL PULL BOXES
6. CONDUIT FROM SERVICE BOX AND CABINET SHALL BE SCHEDULE 80 PVC. ALL OTHER CONDUIT SHALL BE SCH. 80 PVC OR HDPE.



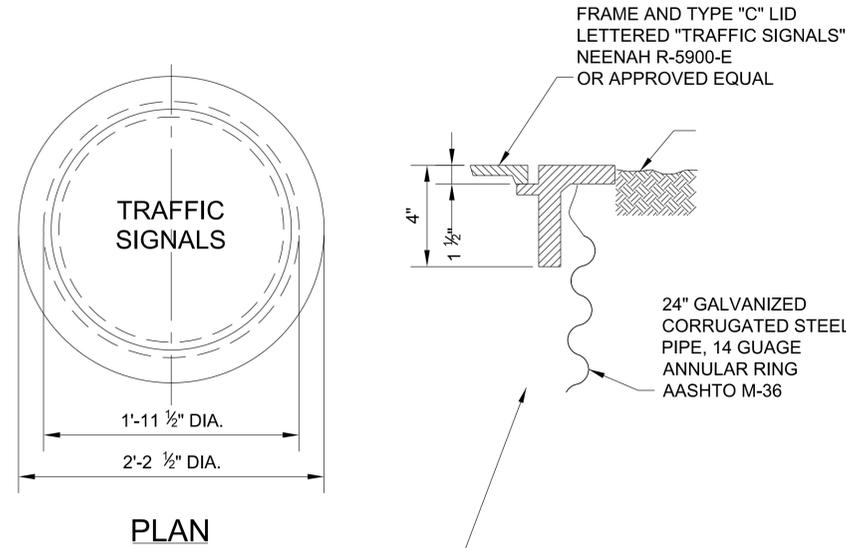
SECTION

PRIOR TO PULLING FIBER CUT CONDUIT AND REMOVE MIDDLE PORTION OR PULL CONDUITS BACK OUT LEAVING 6" REMAINING IN THE BOX

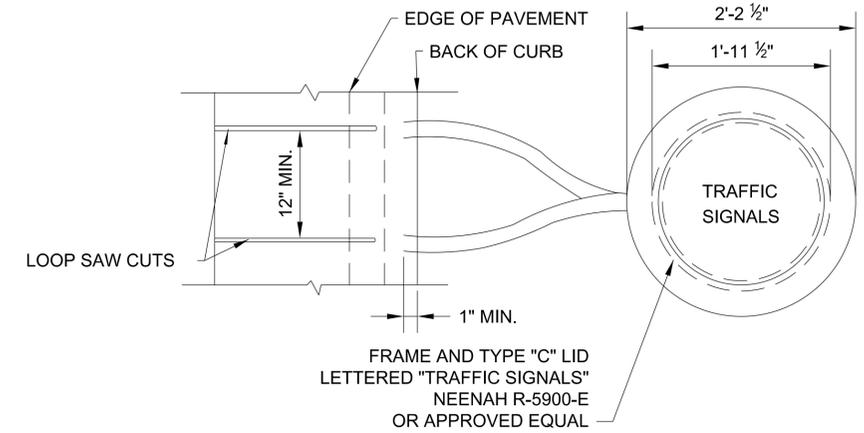
CONSTRUCTION PROCEDURE FOR OPTICAL FIBER SERVICE BOXES:

1. BOX SHALL BE SET TO LINE AND GRADE.
2. 20 FT LONG PIECES OF CONDUIT SHALL BE INSERTED THROUGH DRILLED HOLES TO FACILITATE FIBER PULLING. CENTER OF CONDUIT PIECES SHALL BE IN CENTER OF BOX.
3. CUT CONDUIT AT CENTER OF BOX AND PULL CONDUIT BACK OR REMOVE MIDDLE PORTION LEAVING 6" OF CONDUIT REMAINING IN THE BOX FOR BOTH ENDS OF CONDUIT. CONDUIT FROM BOX SHALL BE FUSION SPLICED TO MAIN LINE CONDUIT.
4. FIBER CONDUIT SHALL BE 24" DEEP AT THE BOX. FIBER OPTIC CONDUIT SHALL BE 48" DEEP BETWEEN BOXES.
5. FIBER CONDUIT MAY BE FUSION SPLICED TO MAIN LINE FIBER OPTIC CONDUIT, WHERE REQUIRED, A MINIMUM OF 10 FEET AWAY FROM CENTER OF BOX.
6. FIBER CONDUIT HOLES SHALL BE SEALED ON INSIDE AND OUTSIDE OF BOX.

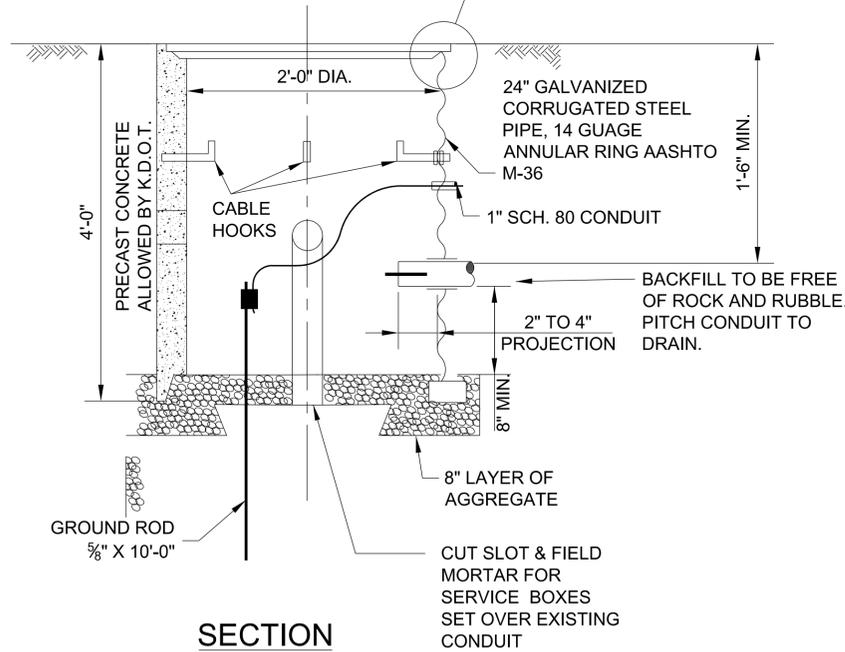
24" SERVICE BOX



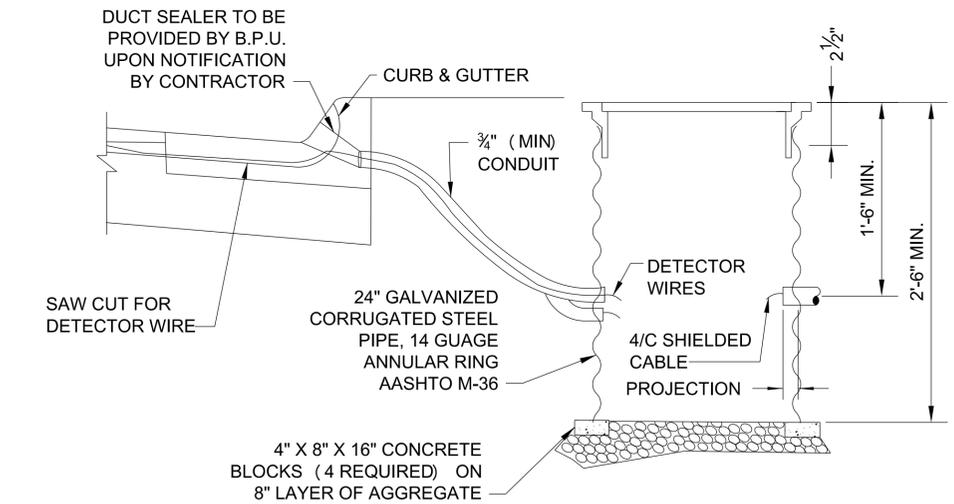
PLAN



PLAN



SECTION



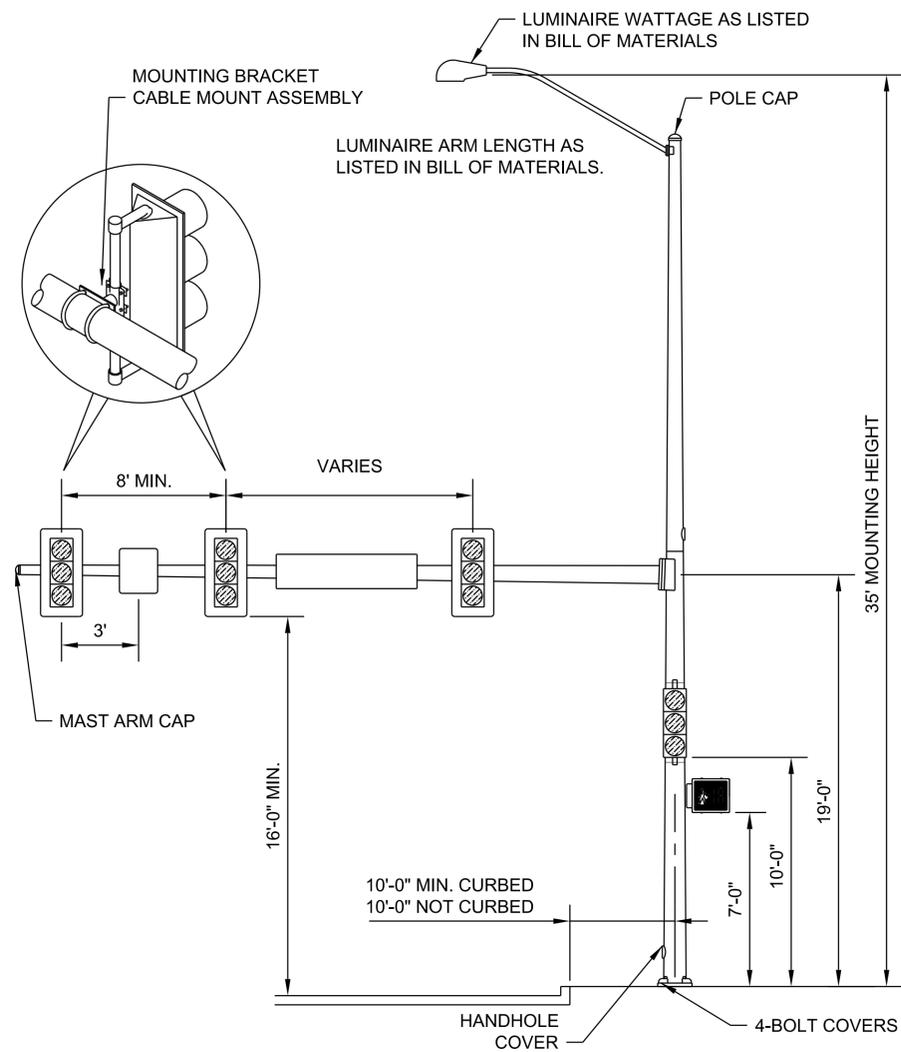
SECTION

- NOTE:**
ALL CONDUITS CONTAINING TRAFFIC SIGNAL CABLES SHALL BE OF THE FOLLOWING TYPE:
- ELBOWS AND CONDUIT ENCASED IN FOOTINGS SHALL BE SCHEDULE 80 PVC.
 - ALL CONDUIT UNDER ROADWAY PAVEMENT SHALL BE RED SCHEDULE 80 HDPE.
 - ALL CONDUIT SHALL BE SCHEDULE 80 PVC.

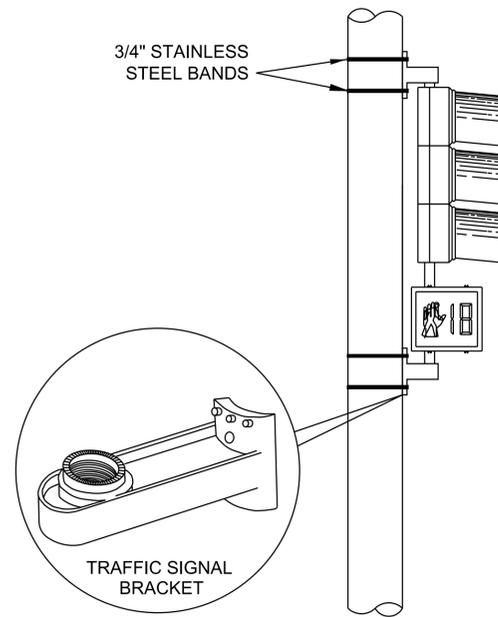
TRAFFIC SIGNAL DETAILS 4 OF 12
JUNCTION BOX AND
SERVICE BOX DETAILS
CITY OF KANSAS CITY, KANSAS
PUBLIC WORKS DEPARTMENT
TRAFFIC DIVISION



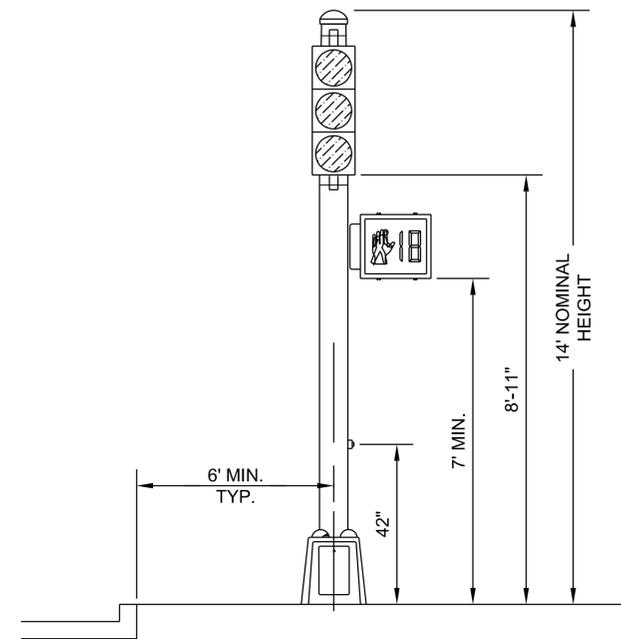
DESIGNED:	GBA	DRAWN:	GBA
CHECKED:	KCK	DATE:	3/20/2017
SCALE:	N/A	SHEET NO.:	



STEEL COMBINATION STREET LIGHTING & SIGNAL POLE

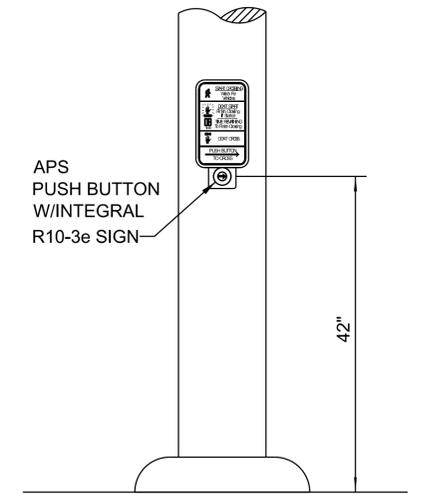


POLE BAND AND CLAMP MOUNTING DETAIL

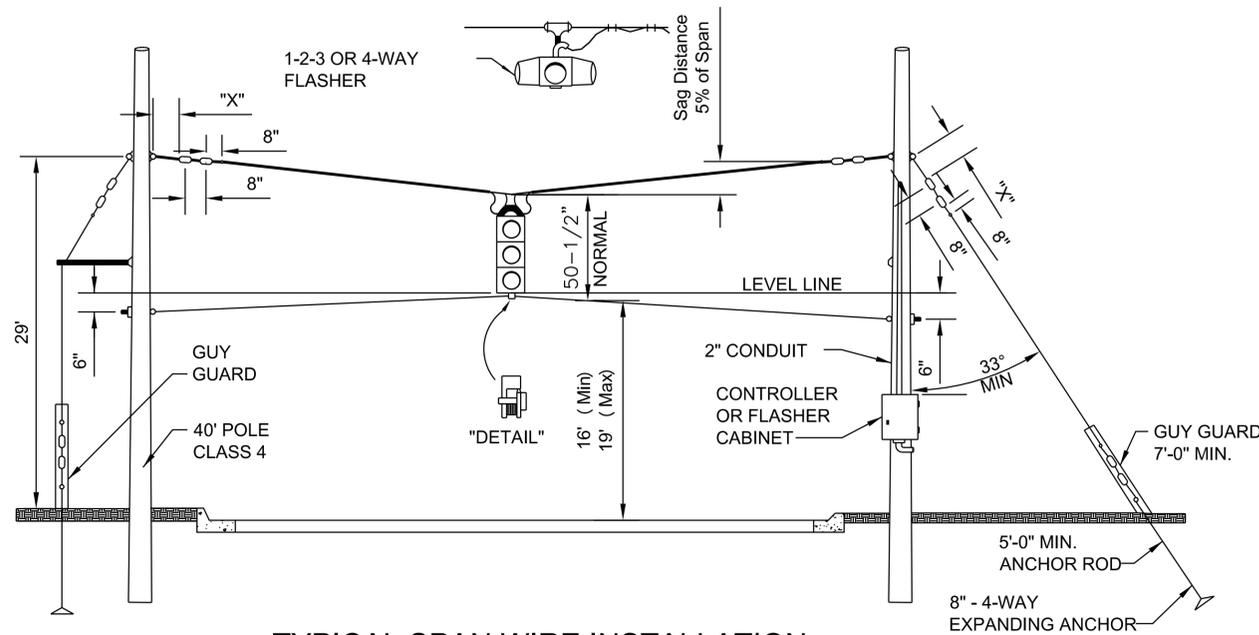


ALUMINUM SIGNAL PEDESTAL POLE

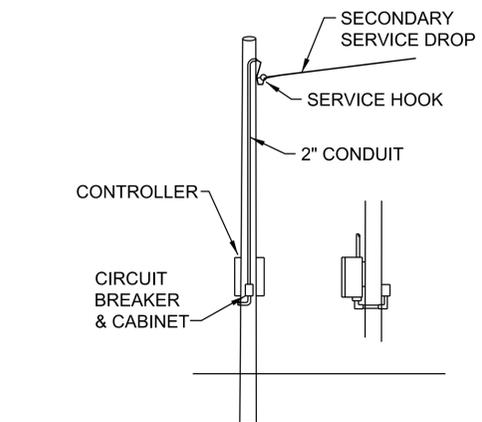
- NOTES:**
- 1) PEDESTRIAN PUSH BUTTON SHALL BE PARALLEL TO THE CROSSWALK AND FACING THE INTERSECTION.
 - 2) COUNT DOWN TIMER SHALL FACE THE CROSSWALK.



PEDESTRIAN PUSH BUTTON



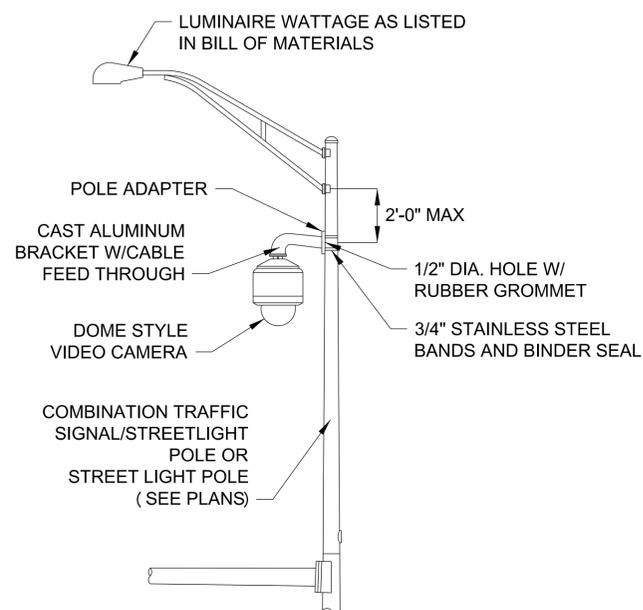
TYPICAL SPAN WIRE INSTALLATION



SECONDARY SERVICE DETAIL FOR SPAN WIRE INSTALLATION

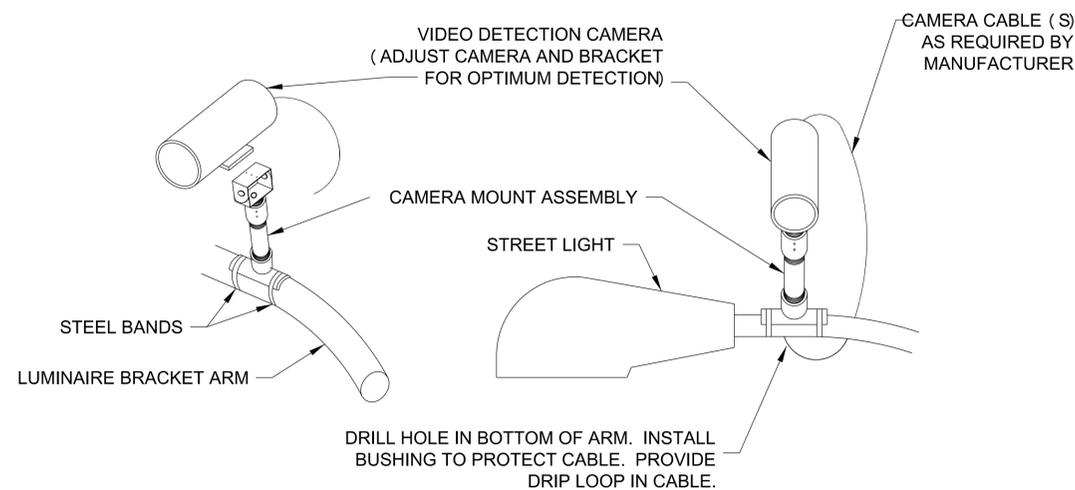
TRAFFIC SIGNAL DETAILS 5 OF 12	
SIGNAL POLE AND SPAN WIRE DETAILS	
CITY OF KANSAS CITY, KANSAS	
PUBLIC WORKS DEPARTMENT	
TRAFFIC DIVISION	
DESIGNED: GBA	DRAWN: GBA
CHECKED: KCK	DATE: 3/20/2017
SCALE: N/A	SHEET NO.:

CCTV CAMERA MOUNTING DETAIL

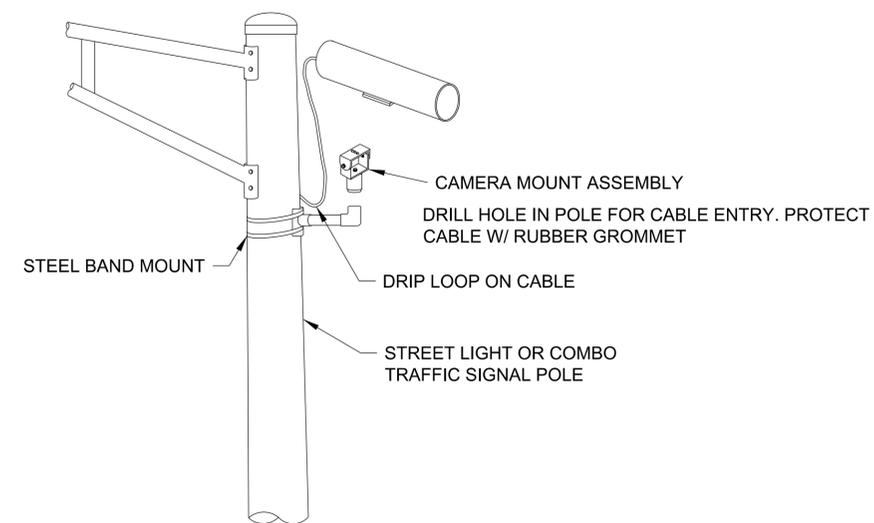


- NOTE:
1. ALL CONDUITS CONTAINING PTZ CAMERAS SHALL BE RED HDPE SCHEDULE 80 OR SCHEDULE 80 PVC UNLESS OTHERWISE NOTED.
 2. PTZ CAMERA SHALL BE MOUNTED AND ORIENTATED SO THAT THE POLE ARM DOES NOT OBSCURE VIEW OF CAMERA.
 3. MOUNTING BRACKET SHALL BE SKYBRACKET CABLE CLAMP KIT (#SS-SBC120-SCK).

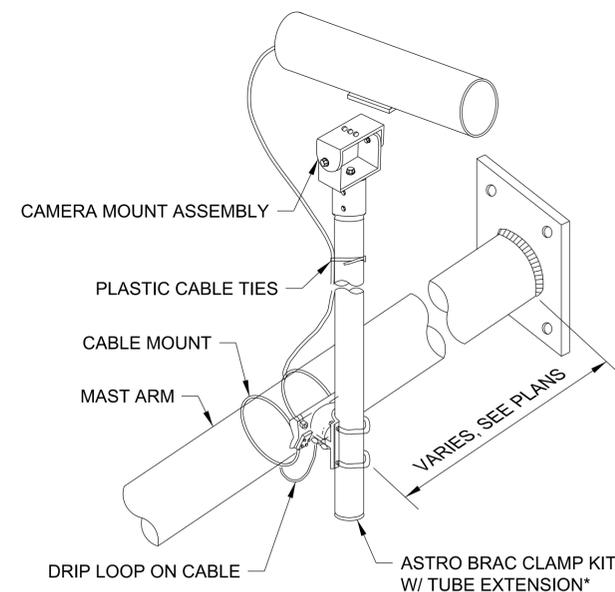
VIDEO DETECTION CAMERA MOUNTING DETAILS



LUMINAIRE BRACKET MOUNT



POLE-SIDE MOUNT



NOTE:
DRILL HOLE IN BOTTOM OF MAST ARM FOR CABLE ENTRY. PROTECT CABLE W/ RUBBER GROMMET.

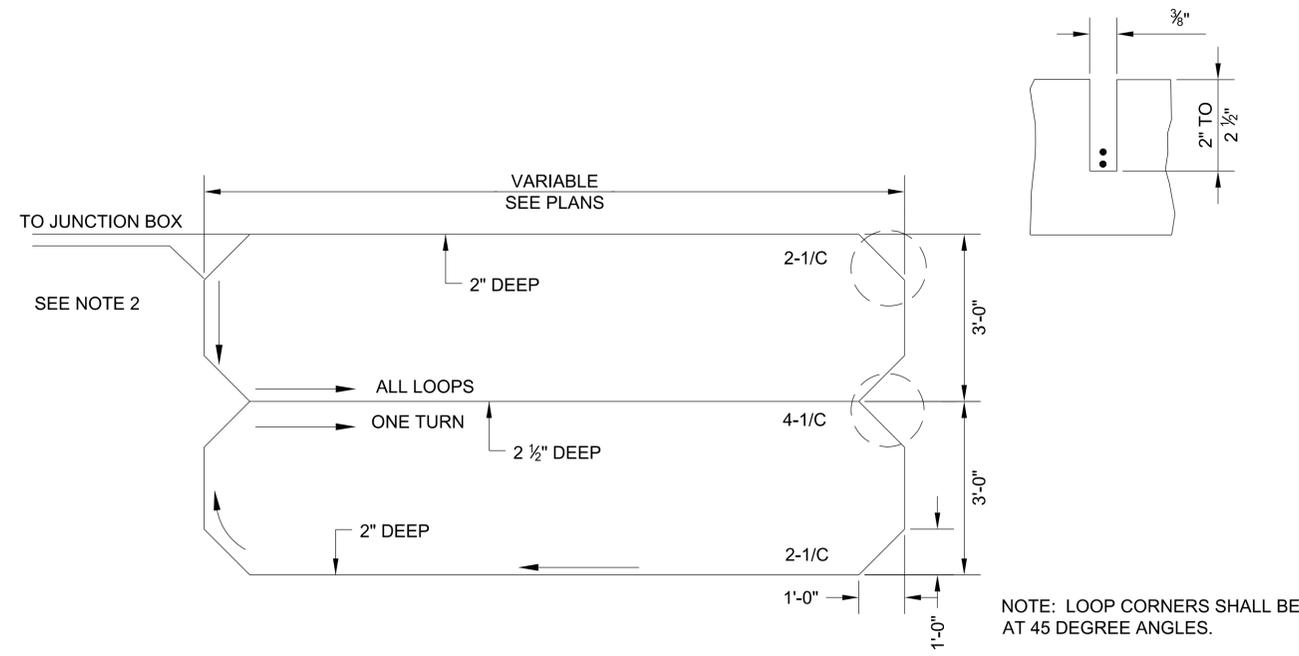
* TUBE EXTENSION SHALL BE 73" UNLESS OTHERWISE NOTED.

MAST ARM MOUNT

NO.	DATE	REVISIONS	BY

TRAFFIC SIGNAL DETAILS 6 OF 12
VIDEO DETECTION CAMERA
MOUNTING DETAILS
CITY OF KANSAS CITY, KANSAS
PUBLIC WORKS DEPARTMENT
TRAFFIC DIVISION

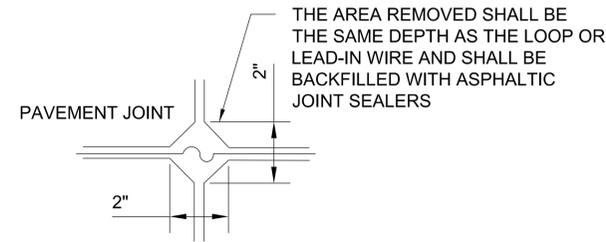
DESIGNED: GBA	DRAWN: GBA
CHECKED: KCK	DATE: 3/20/2017
SCALE: N/A	SHEET NO.:



QUADRAPOLE LOOP DETECTOR DETAIL

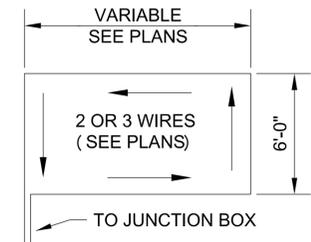
NOTE: LOOP CORNERS SHALL BE AT 45 DEGREE ANGLES.

- NOTES:
1. FILL SLOTS WITH A HOT APPLIED, RUBBERIZED ASPHALT SEALANT TO WITHIN 1/8" OF PAVEMENT SURFACE.
 2. DETECTOR LEAD IN CABLE AND LOOP WIRE SHALL BE CONTINUOUS RUNS WITHOUT SPLICES. TWIST LOOP WIRES 2 TURNS PER FOOT BETWEEN THE DETECTOR LEAD IN CABLE AND LOOP.
 3. LOOP SLOTS CUT IN THE BASE MAY BE REDUCED IN DEPTH BY THE SURFACE COURSE TO BE APPLIED.



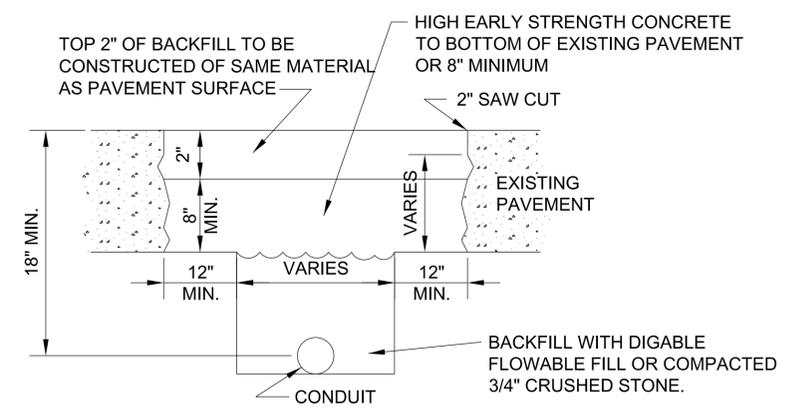
ALTERNATE METHOD

NOTE: 6' x 6' LOOP SLOTS SHALL BE 2" DEEP.

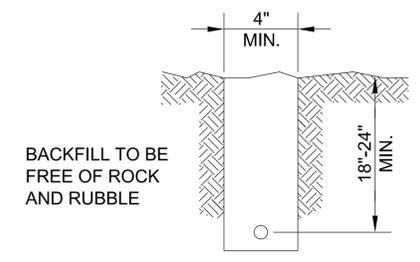


MULTIPLE TURN LOOP DETECTOR DETAIL

TRENCHING



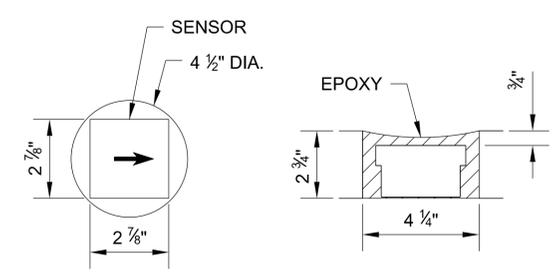
PAVED AREAS



UNPAVED AREAS

VEHICLE SENSOR NODE

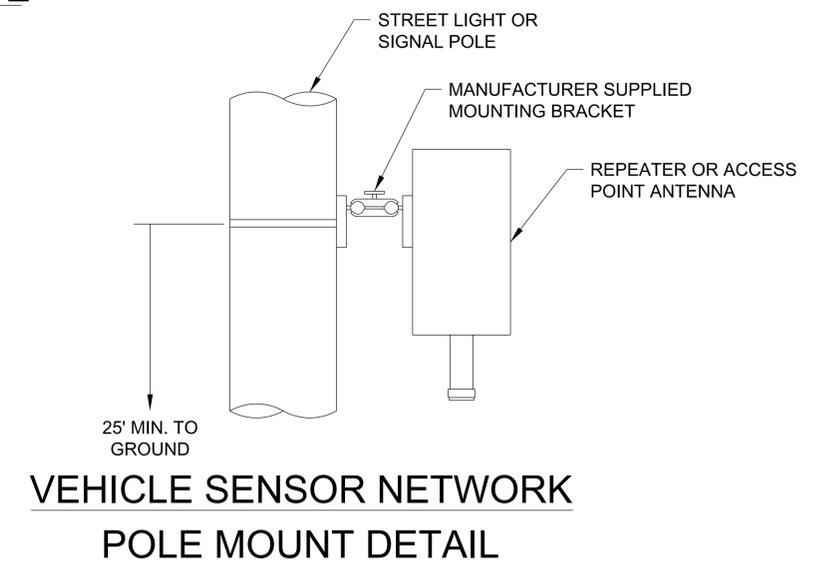
NODE INSTALLATION



PLAN

ELEVATION

- NODE INSTALLATION NOTES:
1. PRIOR TO INSTALLATION, NOTE SENSOR'S ID, LANE NUMBER, AND LOCATION IN LANE.
 2. UNLESS OTHERWISE SPECIFIED, INSTALL THE SENSOR IN THE MIDDLE OF THE LANE.
 3. CORE A HOLE AT LEAST 2 3/4" DEEP, SO THAT SENSOR WILL BE A MINIMUM OF 3/4" BELOW SURFACE.
 4. INSTALL SENSOR FLAT IN THE CORED HOLE WITH ARROW PAINTED IN DIRECTION OF TRAVEL
 5. IF MULTIPLE SENSORS PER LANE ARE INSTALLED, THEY SHOULD BE 20' APART, UNLESS OTHERWISE NOTED.

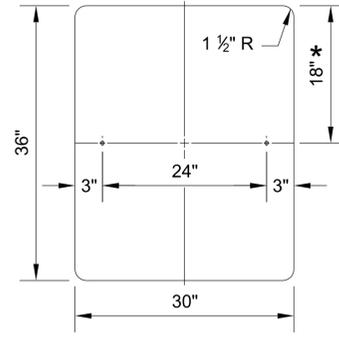
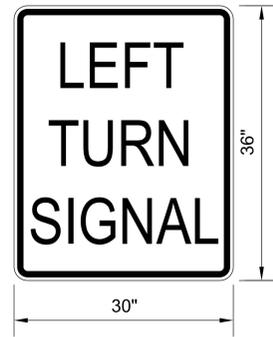


VEHICLE SENSOR NETWORK POLE MOUNT DETAIL

TRAFFIC SIGNAL DETAILS 7 OF 12	
TRENCHING AND DETECTION DETAILS	
CITY OF KANSAS CITY, KANSAS	
PUBLIC WORKS DEPARTMENT	
TRAFFIC DIVISION	
DESIGNED: GBA	DRAWN: GBA
CHECKED: KCK	DATE: 3/20/2017
SCALE: N/A	SHEET NO.:

SIGN FACE DETAILS

R10-10L



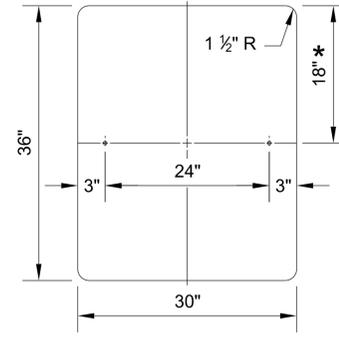
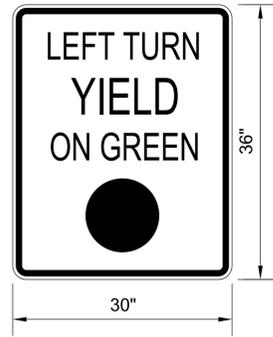
* DRILL ONE HOLE AT STATED DIMENSIONS. LEVEL SIGN AND DRILL THE SECOND HOLE.

COLORS
 LEGEND - BLACK (NON-REFLECTIVE)
 BACKGROUND - WHITE (REFLECTIVE)

BORDER
 INDENT - 3/8"
 WIDTH - 5/8"

LETTERING
 SERIES C - 5" UPPER CASE

R10-12



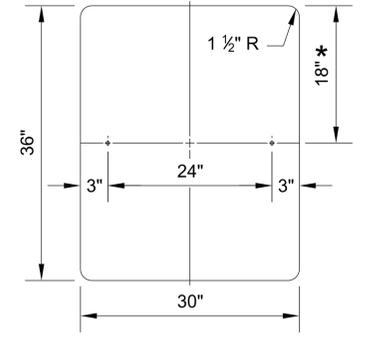
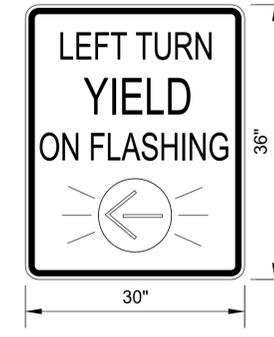
* DRILL ONE HOLE AT STATED DIMENSIONS. LEVEL SIGN AND DRILL THE SECOND HOLE.

COLORS
 LEGEND - BLACK (NON-REFLECTIVE)
 BACKGROUND - WHITE (REFLECTIVE)
 SYMBOL - GREEN (REFLECTIVE)

BORDER
 INDENT - 3/8"
 WIDTH - 5/8"

LETTERING
 SERIES C - 3" & 4" UPPER CASE

R10-SPECIAL



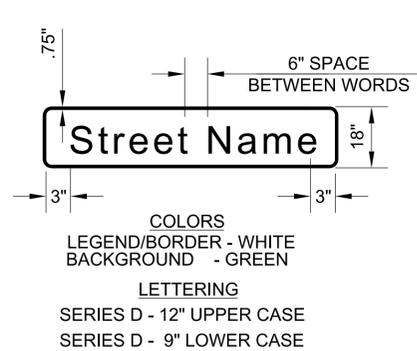
* DRILL ONE HOLE AT STATED DIMENSIONS. LEVEL SIGN AND DRILL THE SECOND HOLE.

COLORS
 LEGEND - BLACK (NON-REFLECTIVE)
 BACKGROUND - WHITE (REFLECTIVE)
 SYMBOL - YELLOW (REFLECTIVE)

BORDER
 INDENT - 3/8"
 WIDTH - 5/8"

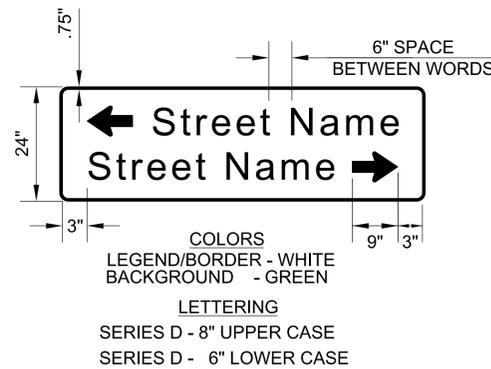
LETTERING
 SERIES C - 3" & 4" UPPER CASE

STREET NAME



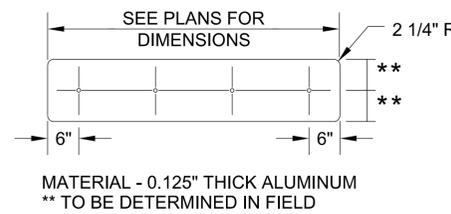
COLORS
 LEGEND/BORDER - WHITE
 BACKGROUND - GREEN

LETTERING
 SERIES D - 12" UPPER CASE
 SERIES D - 9" LOWER CASE



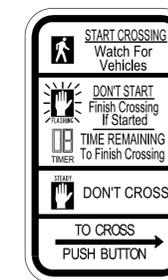
COLORS
 LEGEND/BORDER - WHITE
 BACKGROUND - GREEN

LETTERING
 SERIES D - 8" UPPER CASE
 SERIES D - 6" LOWER CASE



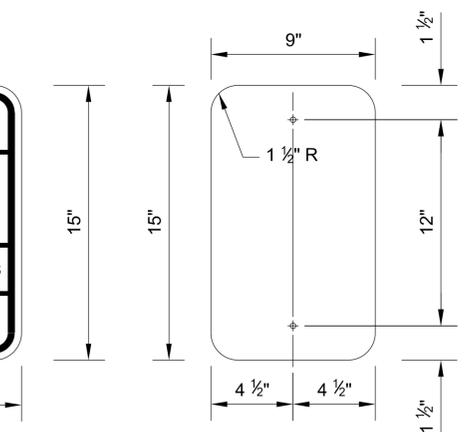
MATERIAL - 0.125" THICK ALUMINUM
 ** TO BE DETERMINED IN FIELD

R10-3e

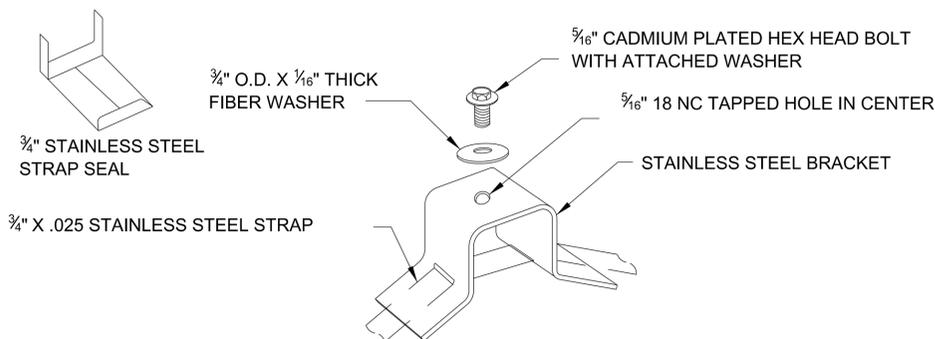


COLORS
 LEGEND/BORDER - BLACK
 BACKGROUND - WHITE (RETROREFLECTIVE)
 UPRAISED HAND SYMBOL, TIMER - ORANGE (RETROREFLECTIVE) ON BLACK
 PEDESTRIAN SYMBOL - WHITE (RETROREFLECTIVE) ON BLACK
 SIGN SHALL INCLUDE BRAILLE TEXT DESCRIBING THE STREET BEING CROSSED.

BORDER
 INDENT - 3/8"
 WIDTH - 3/8"



SIGN BRACKET DETAIL



BOLT HOLES SHALL BE FIELD DRILLED. INSTALLATION SEQUENCE SHALL BE TO LOOSELY BOLT SIGN TO BRACKETS. BAND THE BRACKETS ON MAST ARM AND TIGHTEN THE BOLTS. DURING FINAL TIGHTENING OF BOLT, THE FIBER WASHER SHALL BE HELD IN PLACE SO THAT IT DOES NOT TURN WITH THE BOLT. IMPROPER TIGHTENING OF BOLT WILL RESULT IN SIGN FACE DAMAGE.

NOTES:

- OVERHEAD STREET NAME AND REGULATORY SIGNS SHALL BE SUBSIDIARY TO "TRAFFIC SIGNAL INSTALLATION."
- ALL OVERHEAD STREET NAME SIGN FACE SHEETING SHALL BE VIP SHEETING.
- ALL OVERHEAD STREET NAME SIGNS SHALL HAVE LEGENDS CENTERED ON THE FACE. THE LETTER SPACING SHALL BE 150% THE SPACING IN FHWA'S STANDARD ALPHABETS FOR HIGHWAY SIGNS.
- ACTUAL SIZE DRAWINGS OF THE PROPOSED SIGNS SHALL BE SUBMITTED TO THE ENGINEER FOR APPROVAL.
- REGULATORY SIGN BLANKS SHALL BE 0.080-INCH ALUMINUM. MOUNTING BRACKET AND BANDING SHOWN IN THE SIGN BRACKET DETAIL SHALL BE USED.

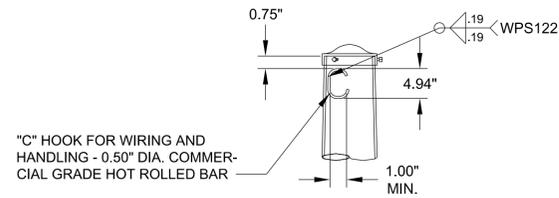
TRAFFIC SIGNAL DETAILS 8 OF 12

SIGN DETAILS

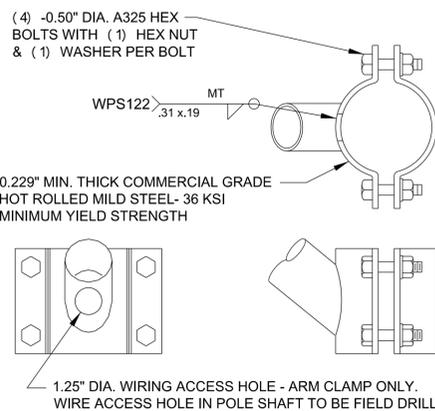
CITY OF KANSAS CITY, KANSAS
 PUBLIC WORKS DEPARTMENT
 TRAFFIC DIVISION



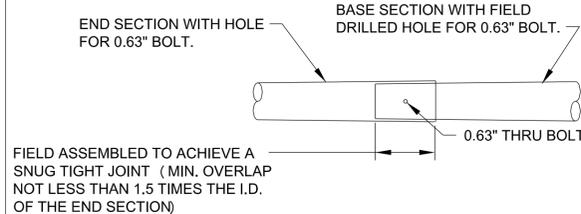
DESIGNED:	GBA	DRAWN:	GBA
CHECKED:	KCK	DATE:	3/20/2017
SCALE:	N/A	SHEET NO.:	



DETAIL 1 POLE TOP



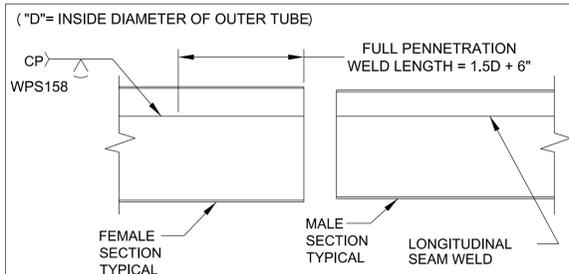
DETAIL 2 LUMINAIRE ARM ATTACHMENT



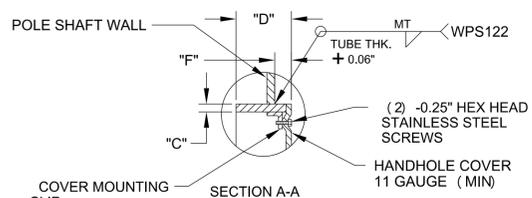
ARM SECTION DATA

SPAN (FT)	BASE SECTION		END SECTION		
	LENGTH (FT)	GAUGE OR THK. (IN)	BASE DIA. (IN)	LENGTH (FT)	GAUGE OR THK. (IN)
52.00	50.00	7	6.62	3.90	7
55.00	50.00	7	6.62	6.90	7
60.00	19.42	0.250	12.00	43.15	7
65.00	22.99	0.250	12.00	44.58	7

DETAIL 3 SIGNAL ARM SLIP JOINT



52',55',60',65' MAST ARM WELD REINFORCEMENT
DETAIL 4 MAST ARM WELD REINFORCEMENT



SPAN (FT)	"A" I.D. (IN)	"B" I.D. (IN)	"C" THK (IN)	"D" DEPTH (IN)	"E" RADIUS (IN)	"F" PROJ (IN)
14.00						
16.00						
18.00	5.50	3.50	0.375	2.00	1.50	0.50
20.00						
22.00						
24.00	6.75	4.00	0.375	3.00	2.00	0.50
26.00						
28.00						
30.00						
32.00	6.75	4.00	0.375	3.00	2.00	0.50
34.00						
36.00						
38.00						
40.00						
42.00	6.75	4.00	0.375	3.00	2.00	0.50
44.00						
46.00						
48.00						
50.00						
52.00	6.75	4.00	0.375	3.00	2.00	0.50
55.00						
60.00	6.75	4.00	0.375	3.00	2.00	0.50
65.00						

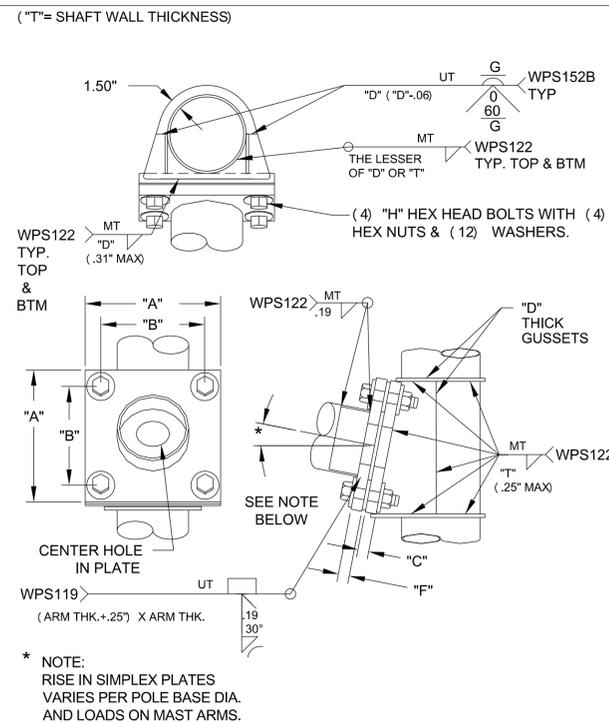
DETAIL 5 UPPER HANDHOLE

ALL WELDS SHALL HAVE 100% VISUAL TESTING PERFORMED, WITH COMPLETE JOINT PENETRATION WELDS TO HAVE 100% UT TESTING, AND ALL OTHER WELDS TO HAVE 25% MT TESTING.

WELDING & TESTING

ALTHOUGH RARE, VIBRATIONS SEVERE ENOUGH TO CAUSE DAMAGE CAN OCCASIONALLY OCCUR IN STRUCTURES OF ALL TYPES. BECAUSE THEY ARE INFLUENCED BY MANY INTERACTING VARIABLES, VIBRATIONS ARE GENERALLY UNPREDICTABLE. THE USER'S MAINTENANCE PROGRAM SHOULD INCLUDE OBSERVATION FOR EXCESSIVE VIBRATION AND EXAMINATION FOR ANY STRUCTURAL DAMAGE OR BOLT LOOSENING. THE VALMONT WARRANTY SPECIFICALLY EXCLUDES FATIGUE FAILURE OR SIMILAR PHENOMENA RESULTING FROM INDUCED VIBRATION, HARMONIC OSCILLATION OR RESONANCE ASSOCIATED WITH MOVEMENT OF AIR CURRENTS AROUND THE PRODUCT.

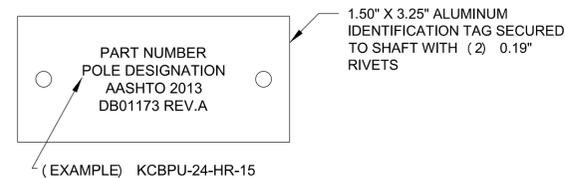
VIBRATION DISCLAIMER



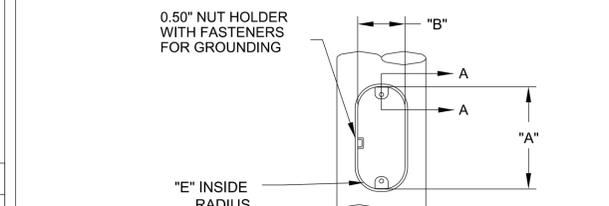
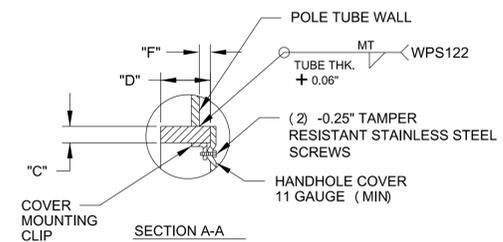
SIGNAL ARM ATTACHMENT DATA

ARM SPAN (FT)	"A" (IN)	"B" (IN)	POLE PLATE "C" (IN)	ARM PLATE "F" (IN)	"D" (IN)	CENTER HOLE DIA. (IN)	"H" (IN)
14.00							
16.00							
18.00	16.75	13.50	2.00	2.00	0.375	7.64	1.25 X 6.25
20.00							
22.00							
24.00	17.75	14.50	2.00	2.00	0.375	7.64	1.25 X 6.25
26.00							
28.00							
30.00	17.75	14.50	2.00	2.00	0.375	7.64	1.25 X 6.25
32.00							
34.00	17.75	14.50	2.00	2.00	0.375	8.50	1.25 X 6.25
36.00							
38.00	18.75	15.50	2.00	2.25	0.375	9.50	1.25 X 6.50
40.00							
42.00							
44.00	18.75	15.50	2.00	2.25	0.375	7.00	1.25 X 6.50
46.00							
48.00							
50.00							
52.00	20.25	17.00	2.00	2.25	0.375	7.00	1.25 X 6.50
55.00							
60.00	22.25	18.50	2.00	2.00	0.375	7.25	1.50 X 6.50
65.00	22.25	18.50	2.00	2.00	0.375	7.50	1.50 X 6.50

DETAIL 6 SIGNAL ARM ATTACHMENT



DETAIL 7 I.D. TAG



SPAN (FT)	"A" I.D. (IN)	"B" I.D. (IN)	"C" THK (IN)	"D" DEPTH (IN)	"E" RADIUS (IN)	"F" PROJ (IN)	"G" MTG. HEIGHT (FT)
14.00							
16.00							
18.00	10.00	4.50	0.500	2.00	2.25	0.50	1.54
20.00							
22.00							
24.00	10.00	4.50	0.500	2.00	2.25	0.50	1.54
26.00							
28.00							
30.00							
32.00	10.00	4.50	0.500	2.00	2.25	0.50	1.54
34.00							
36.00							
38.00							
40.00							
42.00	10.00	4.50	0.500	2.00	2.25	0.50	1.67
44.00							
46.00							
48.00							
50.00							
52.00	10.00	4.50	0.500	2.00	2.25	0.50	1.71
55.00							
60.00	10.00	4.50	0.500	2.00	2.25	0.50	1.79
65.00							

DETAIL 8 LOWER HANDHOLE

TRAFFIC SIGNAL DETAILS 11 OF 12
TRAFFIC SIGNAL
MAST ARM STRUCTURES
CITY OF KANSAS CITY, KANSAS
PUBLIC WORKS DEPARTMENT
TRAFFIC DIVISION



DESIGNED: Valmont
CHECKED: Valmont
SCALE: N/A

DRAWN: Valmont
DATE: 9/30/2016
SHEET NO.:

